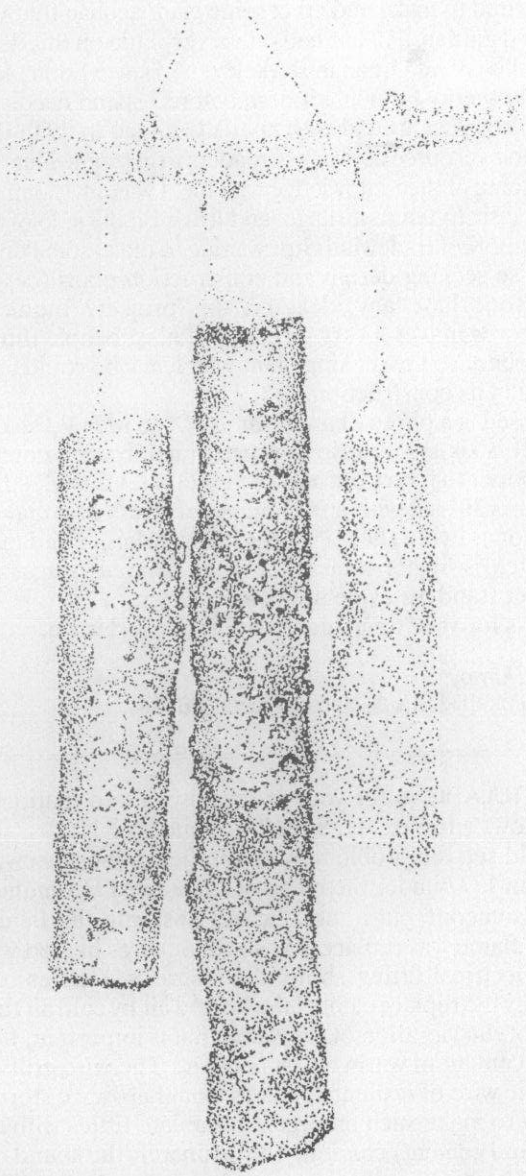
VOLUME 10 #2 DECEMBER 1994 PRICE $3.50

FOR THE DESIGN, CONSTRUCTION AND ENJOYMENT OF UNUSUAL SOUND SOURCES

EXPERIMENTAL MUSICAL INSTRUMENTS



MISTPOUFFERS AND MOODUS NOISES

Hello again, good people.

In this issue of *EMI* we return to some themes from our last, with an interest in natural forces providing much of the music and much of the motive for thought. We have writings from two more makers of aeolian harps (string instruments sounded by the wind). One emphasizes fine woodwork in a fairly traditional instrument; the other, a more exploratory approach. We also return to the topic of nature sound in music, with a discussion of issues in nature-sound composing and recording. This is accompanied by an account of the recording of a dawn chorus of animal sounds in the Amazon. Reed Ghazala is back to describe his instrument the *Morpheum*, and to tell of a world of unexplained natural audible phenomena. We visit briefly again with Bill Colvig, who provides plans for making a simple metal tube mallet instrument. Additional practical information on tubular chimes follows.

... Plus, we have the usual letters, reviews, notices, and addtional feature articles. Open up, and read.

IN THIS ISSUE

Drawing above: Windchime made by Steve Heitzeg. See the article staring on page 16. Drawing by Robin Goodfellow

ALOHA

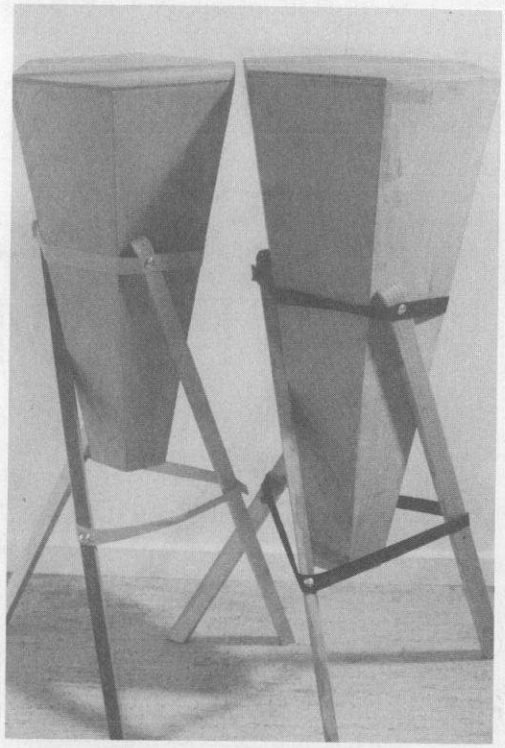
Recently, after I'd put up an Indonesian bamboo percussion whirligig in my yard, I was inspired to make and erect some giant aeolian flutes to add some tones to my little sound garden. *EMI* has had only a very little on this device (October 1989 issue, Doug Hollis' Wind Organ in Berkeley) and since I don't know anything about flute design and theory I thought it best, before I spend needlessly anymore time, effort and cash in toying around with my PVC piping to write EMI once again and pool this valuable resource network of readers to get some hints from someone who'd like to share some of their knowledge with me. I was envisioning using lengths of 4" PVC pipe in the six to ten foot range, and living on the side of a hill in Hawaii I have an endless supply of tradewinds just waiting to make some noise.

I'm also seeking design and construction plans for a single manual virginal. Does anyone have any ideas on this project? Inquiring into kits, Hubbard Harpsichords makes a very nice kit but it's a couple thousand more than what I want to spend. So I'm seeking plans which maybe could incorporate some existing hardware in its construction.

Enclosed is a photo of an evolution of an idea I'd shared in EMI the last time I wrote. It is six-sided stave construction, all wood conga, which isn't bad for a novice cooper to figure out and put together. One is 24" tall with an 11" diameter. The other is 30" tall with an 11" diameter. Both use mahogany ply for their tops. The next ones in the shop are progressively larger and maybe I'll try thinner tops as the pitch is higher than traditional skinned congas are. Note the easy and convenient stand we came up with for them.

Thanks for your time and yet another good issue.

Pete Hurney
665 Ulukahiki Street, Kailua, Hawaii 96734



Wooden congas by Peter Hurney

CONGRATULATIONS for your articles [with information on flame organs from] M. Meadows and Prof. Hall (*EMI* Volume 10 #1).

I would see the problem from another point of view. The singing flame was invented in 1777 under the name of "Chemical Harmonica" using hydrogen.

Then someone put a metallic grill just into the flame. 80 years after (circa 1857) the flame was replaced by a grill of wires heated with electricity.

The electrical fitting shows that there is a series of expansions of the air followed by the replacement of the heated air by cold air that creates the vibration.

It is not the vibration of the flame that is important. It is the heating of the air and replacement of warm air by cool air. The wire grill can be easily made with the electric wire of ordinary heaters from hardware stores.

I tried to make such an organ in the late fifties with an "Everit" (mixture of asbestos and cement) conduit. Unfortunately the sound comes very slowly so we could not use it in our "Structures Sonores" orchestra. The conduit was 2 meters long. The funny thing is that, when the tube was singing in my workshop, visitors were unable to guess where the sound was coming from. As there is no attack, the sound is difficult to locate.

Bibliography: Bouasse devotes several pages, not only to fire organs but to different sorts of sounds created by heat (Trevelyan, Sondhaus works). I don't have his book here [Henri Bouasse, *Instruments à Vent*, Paris, 1929-30]. I just have here two pages of A. Foch *Acoustique* referring to "Harmonica chimique" and "Harmonica thermique" [a photocopy of these pages, including descriptions in French and mathematical formulations, was enclosed with this letter].

Moglia Congratulations for the Moglia article [*EMI* Vol 10 #1, on fire organ maker Michel Moglia]. The man and the work are both very interesting. His work is very spectacular and the man very open and honest.

Eolian harps. When I use fishing nylon strings, I boil them in boiling water for 20 minutes. This is supposed to decrease its elasticity and make the nylon stiffer. I am not sure this process is useful. I do it anyway. Do you have any idea on that matter?

F. Baschet

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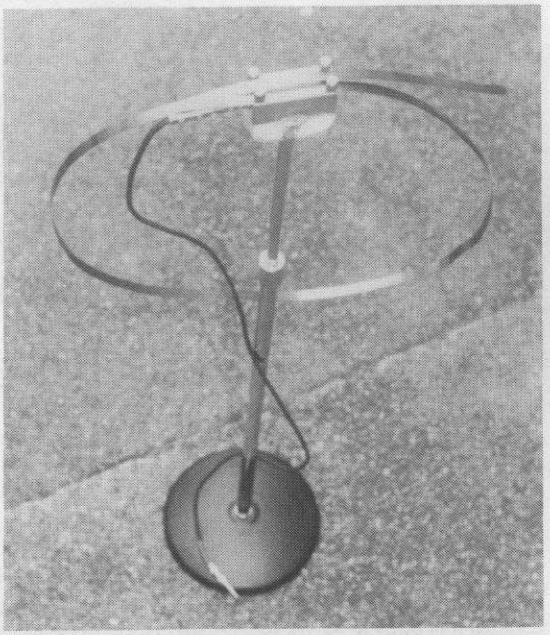
SUBMISSIONS: Experimental Musical Instruments welcomes submissions of articles relating to new or unusual musical instruments. A query letter or phone call is suggested before sending articles.

ENCLOSED ARE PHOTOS of the instrument I have recently built which captures the sound I wanted from the metal freight strapping [referred to in the author's bio at the end of Steve Ball's article on pickup winding in EMI Vol IX #4]. It is very simple, and consists of one EMG jazz bass pickup encapsulated with extra magnets and mounting hardware for a microphone stand. The Ex-Pensives used it as a sound effect in a recent tape. It can hold one or two straps after small holes have been punched in the straps. These holes align with the thumb screws. If you punch the holes in such a way that leaves a few inches of slack on the opposite side of the long length of strap, you have an extra twanging sound effect. If one of the two mounting screws is loosened, you can vary the pitch of the twang. My only regret in its design is my decision to mount an in-line phone jack directly onto the case (a good length of cable coming out would have been a better decision). It is one of the most gratifying of instruments to play in terms of stress relief, as it produces the most raucous and cacophonous sounds from a light tap of the hand.

Steve Ball



Steve Ball's stress-relieving metal strap instrument

NOTES FROM HERE AND THERE

ONE OF EMI'S IMPORTANT SOURCES of information for our article on Deagan Organ Chimes appearing in the December 1993 issue was Marion B. Cox. He owns one of the few surviving sets of chimes, and plays them with great skill. Another chime owner and player is Ellen Schultze of Sacramento, California. Her stories of the chimes and other instruments appeared more recently in *EMI*'s September 1994 issue. Following that first article, the two chimers began a correspondence, which led eventually to what surely must have been a one-of-a-kind event – a concert featuring the two chime sets, side by side, in solos and duets. To make this possible, Mrs. Schultze arranged to transport her chime set from her home in central California to Bountiful, Utah, where the concert featuring sacred songs, patriotic songs, and familiar old time melodies took place on September 14. The concert was a success; the chimes sounded as lovely as ever, and the event in all its uniqueness made the front page of the local *Davis County Clipper* newspaper.

THE ARTICLES ON PYROPHONES in *EMI*'s last issue prompted William Steinmayer to write on the subject of flame *speakers*. The idea here is to have a speaker-like mechanism which can radiate a recorded sound signal to the surrounding air, in which a controlled flame replaces the more familiar speaker cone. In the book *Collecting Phonographs and Gramophones* by Christopher Proudfoot (Studio Vista, London, 1980), Mr. Stainmayer found a discussion of a windup gramophone called "The Flamephone." Included was the ad reproduced below, which originally appeared in now defunct magazine The *Sound Wave* for May 1922. Neither the ad nor Christopher Proudfoot's accompanying text offer details on just how the Flamephone worked. But, based upon the picture, one can speculate that the air pressure pulses coming off of the gramophone diaphragm may have been directed to the base of the glass flame, causing the flame to reproduce the recorded signal in its waxing and waning. This would in turn send pressure pulses out into the atmosphere.

A more modern "flamephone" is described in a 10-page booklet called *The Flame Speaker: A New & Novel Way to Reproduce Sound* (no author credited; published in 1993 and available for $10 from Electroman, PO Box 24474, New Orleans, LA 70184). The Electroman flame speaker uses a high voltage modulated electrical current (the signal) conducted through the length of a flame by the ions created in the combustion process. The booklet describes the basic principles behind the flame

MAY, 1922. THE SOUND WAVE.

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Something entirely new in acoustical science. By the application of a pulsating gas flame, the usual reproducing horn is entirely eliminated. The sound waves as they impinge the air are conducted through two columns of gas flame, thereby being reproduced in all their natural volume and tonal purity.

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Write for Brochure. Agents Terms with exclusive Territory on application.

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Sole Manufacturers: SCIENTIFIC & PROJECTIONS, LTD., 5, Crawford Passage, Farringdon Road. London, E.C.1. Telephone: HOLBORN 4783.

The Flamephone, in an advertisement appearing in 1922 (reprinted in Christopher Proudfoot's Collecting Phonotgraphs & Gramophones). Components to notice: the windup crank for the gramophone spring on the side of the casing; the gas hose coiled alongside; the diaphragm housing just above the needle with rigid pipe leading to two burners on one side, and small speaker horn curving around behind from the other side. The four panels may be intended as mirrors for visual effect, or sound reflectors, or heat barriers for safety.

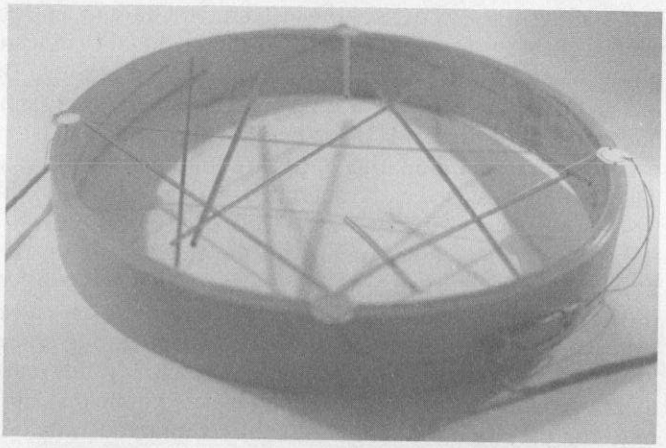
speaker, gives instructions for making one, and concludes with a history (somewhat patchy) of the flame speaker idea.

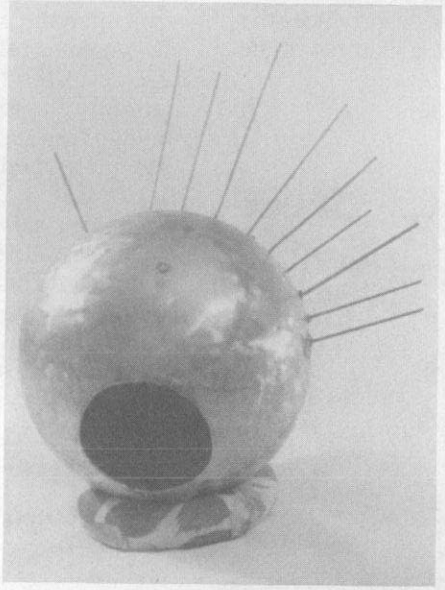
THIS ARCHAEOLOGICAL EVENT was mentioned in *EMI*'s "Recent Articles..." listing last issue, but it is notable enough to draw attention to it more prominently: The tomb of the 5th-century Chinese ruler, the Marquis Yi, has recently come to light, and has proven to be an extraordinary find in the field of ancient musical instruments. The tomb in central China's Hubei Province was originally discovered in 1977, but has only recently been fully reported in Chinese archaeological literature and picked up upon in the west. *Archaeology*'s Jan/Feb 1994 issue carries a fairly comprehensive article on the find, and the Sept. 1994 issue of *National Geographic* carried a shorter blurb with on enticing photograph. The greatest treasure in the tomb was a grand set of 64 tuned bronze bells, the largest weighing 410 pounds. Each bell is designed to produce two pitches, depending on striking location. Also found were sets of stone chimes (*qing*), and remains of several more perishable instruments, including zithers, drums and several winds.

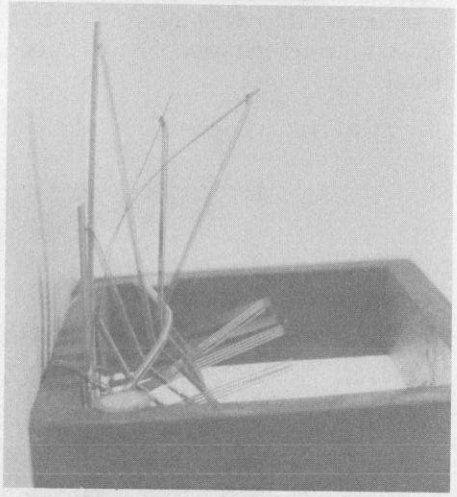
WITH A LITTLE PRODDING from the editor, Grant Strombeck has sent these photographs (right and above) of his several of his instruments. He writes –

I find it difficult to talk about the instruments because I am not primarily an instrument builder. My main focus is the making of music.... The instruments are not fine examples of craftsmanship. They are simple constructions, made of common objects, and they were made to add an acoustic element to my mixed set of sounds.

The first piece on my tape, *Sound Web*, combines electroacoustic instruments and digitally produced sounds. One of the instruments is made of nylon strings and springs stretched on a circular frame. The thing resembles a web, thus the *sound web* is the instrument's name. Another instrument is a set of beryllium copper strips mounted on a rectangular frame with springs woven into the tines of the strips. This instrument sounds like a ratchet or a motor when hooked up to a flange effect. It's called the *Flexyprotuberance*. The *Orb* is a gong/bell made of rods welded to a stainless steel float. It produces long-sustaining gong/bell sounds and looks like sputnik.







Instruments by Grant Strombeck. Upper right: Sound Web. Left: The Orb. Right: Flexy Protuberance.

See this issue's recordings reviews section for a review of Grant Strombeck's tape, *Sound Web*.

JONATHAN PURCELL, from the software company WaveAccess, recently visited EMI's corporate world headquarters here in Nicasio to demonstrate WaveAccess' *WaveRider* hardware and software. WaveRider is a system for reading bio-electrical signals through galvanic skin response (GSR), and digitizing them for the purpose of computer manipulation. The signals can be mapped into musical patterns in MIDI code, ready to be sent to a synthesizer or computer sound card. In other words, WaveRider is a system for translating brainwaves, heartbeat patterns and electrical impulses associated with muscle movement into music. The hardware consists of electrodes that can be strapped to the head or other parts of the body to act as pickups, a computer "peripheral" in the form of a separate interface box, and lead cords to connect these components and a computer.

Once you have gotten used to the idea of reading brainwave patterns into a computer, the key question arises: how does the mapping work – in other words, how do you decide what kind of brain wave pattern yields what kind of music? What are the control parameters? It's not a matter of "think a melody line, hear it come out the speaker" – we don't have access to brain activity on anything like such a sophisticated level, nor would we have the ability to interpret it if we did. The GSR information that the WaveRider electrodes pick up takes the form of signal strength readings over a frequency range of about 3 to 40 Hertz. These strengths and frequencies vary continually as the subject engages in different sorts of mental activity. For the novice the most controllable facet of measurable brainwave activity is an increase in the frequency range known as alpha waves, often associated with a meditative or relaxed mental state.

So how to interpret such information as sound? The obvious approach would be to use simple multipliers to map of brainwave frequency to musical frequency, and intensity to volume. This out to be less than optimal, both in terms of controllable brain wave activity and in terms of musical result. The work of many researchers in the area of biofeedback has turned up subtler ways of looking at the data, and the WaveAccess people have incorporated

a variety of possible approaches into their product. Through the software's interface, the user is offered a range of options in deciding what aspects of the data the computer should look at. Following that, the user has another range of options for turning the results into music. These include choices of scale systems, decisions regarding which factors determine volume, assignment of MIDI channel for different timbres, and creation of algorithms for creating musical patterns. Signals from different electrodes (i.e., different parts of the head or different parts of the body) can by assigned different algorithms and MIDI channels, so that, for instance, the subject's heartbeat can trigger one set of sounds while patterns of muscle movement in the arm trigger another, and brainwaves another. One of the great advantages of MIDI, too, is that in itself it is a neutral code; it can be used to control not only synthesizers, but light systems, or, in fact, anything else that can be programmed to accept commands from a computer and for which someone is willing to write a MIDI interpreter.

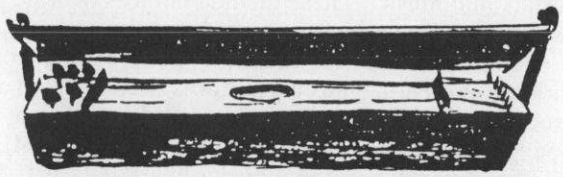
You can see WaveRider primarily as a tool for a most unusual sort of musical exploration, or primarily as a window on one's own bio-electrical activity – a means for practicing biofeedback. WaveRider is available for IBM with Windows or Mac with MAX. Prices range from $750 to $2000. For information contact Jonathan Purcell at WaveAccess, PO Box 4667, Berkeley CA 94704.

CREATIVE APPROACHES TO INTERACTIVE TECHNOLOGY IN SOUND ART is a small book with audio tape, authored by Ros Bandt as part of the *Performing Arts: Process of Realisation* course offered by the School of Education and the School of Humanities in Deakin University's Open Campus Program. It is published by Deakin University, Geelong, Victoria 3217, Australia. *Experimental Musical Instruments* used an extended excerpt from the book as the basis for the article "The Aeolian Harps: Ancient Roots", by Ros Bandt, in our last issue. At the time of our re-publication, we failed to acknowledge the original publisher, Deakin University. *EMI* congratulates Deakin on having published a valuable work, thanks the university for the use of the article, and apologizes for our earlier failure to give proper acknowledgment.

Ms. Bandt's excellent booklet, including the greater portion of the book that was not a part of the *EMI* article, will be of interest to many readers, with sections on individual sound-sculptural works, notes on technology, and aesthetic insights into the nature of sound work. Unfortunately, the booklet is not at this time available for purchase. We will pass the word along if it becomes available.

A REMINDER: *EMI*'s new cassette tape, *From the Pages of Experimental Musical Instruments* Volume 9, is now available. It contains music of instruments that appeared in the four issues of EMI's last volume year, from September 1993 through June 1994. Great stuff! The cost is $8 for subscribers, $10.50 for non-subscribers, from EMI at PO Box 784, Nicasio, CA 94946. *EMI* tapes volumes 6, 7 and 8 also remain available at the same cost. (Earlier volumes are now sold out.)

AEOLIAN HARPS: One Person's Experience



by Tom Pearce

"It's a wind harp, not a breeze harp"

In this issue EMI continues its special aeolian harps feature with two more articles on the subject. Our last issue contained an overview and history of the subject, followed by articles John Oughton, a maker of traditional window harps, and Ros Bandt, who has made more experiental, large-scale aeolian string installations. In this issue we again balance the more traditional with the more exploratory, with this article by Tom Pearce followed by one on the electro-acoustic wind-strings of Richard Lerman.

Over and over it comes to me that everything depends upon perspective. The best thing I had going for me in trying to make an aeolian harp was my ignorance.

A luthier is concerned with creating the instrument to materialize that confluence of energies that is music. Some of those energies come from the musician, some of which are mechanical. Some of those energies are physical sound that goes out to the world. For all his investment in the process, the musician hopes for an instrument that faithfully projects his input. A major facet of that is what we'd call a fiat frequency response.

All this describes a high energy process. We do not have this luxury with aeolian harps. My lack of experience in lutherie left me with a beneficial lack of any notion of what an instrument should sound like and just how to make it hold up to the rigors of it all.

If the prime dictate is to maximize the sound output, then one probably shouldn't be too concerned with the relationship of soundbox dimensions to possible modes; or with sound hole concerns of size, shape, or placement; or with reinforcement.

In looking at basic theory, we see that the string vibrates because of turbulence downwind, and consequently the excitation frequency is determined only by the string diameter and the wind velocity. This suggests several possible avenues of approach. We can choose the number of strings, their size(s), spacing, and material.

I have chosen almost always to use twelve strings, a typical number that seems to be a good compromise between sound output and complexity. If the harp has a bank of strings on only one side, as is usually the case, then the greater the number of strings the greater the risk that the body will deform under the stress. Some deformation occurs with twelve strings, but it is limited. I've used low tension folk guitar strings of different sizes, mixing sizes on a harp. I have always varied the spacing between the strings. One experiment I tried was a double banked instrument with brass strings on both sides, which only seemed to confirm my suspicions about metal strings being too massive for anything but a gale harp.

While the excitation frequency is determined by string and wind parameters, the frequencies we hear are also influenced by the resonance frequencies of the sound box. Simple, non-sound-damping construction suggests a rectangular box shape which, in turn leads to four main modes of oscillation for the air within (length, width, height and the Helmholtz mode). More complicated shaping to attain more varied modes seems to lead inevitably to the need for reinforcement and damping by the blocking and bracing elements. Sound hole considerations don't seem so important either, as they seem to be of use, again, to balance frequency response by favoring bass output.

Good possibilities for woods are the lower density species such as sequoia and the "cedars". Their shortcomings for plucked and bowed instruments do not seem to be such a problem for aeolian harps, and they project a lively sound and make for an instrument that speaks easily. "Speaking easily" is about the highest compliment a harp can get. I have had best results making the entire harp of tone wood. This is easy when using redwood, with which I've had the best luck, because of its wide availability in different sizes. I had thought a basic concept of stringed instruments was to have a relatively large mass at each string end which acted as a reference upon which the string vibrated. That seems to contradict an all redwood construction, but that is where I've had the most success.

While "speaking easily" is the highest praise for a harp, I also enjoy sound variety. This leads me to consider vanes to direct the airflow across the strings very important. Vanes help to locally increase wind velocity and so get maximum output. By inclining them the velocity can be made to vary across the bank of strings and increase the likely range of frequencies excited. It also seems good to keep the vane close to the strings, and I've had good results with a spring-loaded screw-adjusted vane to confirm this, as well as remove this parameter from the demands of initial glue-in-place construction.

Speaking ease and variety also influence a basic decision about harp type. In the literature on the subject we seem to see more about the English preference for using the harp in a window (maybe because of our language bias), but the continental practice of putting it outside has real advantages. It seems to me to be a question of maximizing output in any wind (English) or going for a livelier response, relying on stronger wind (continental). The wall of a building, while it catches wind and can concentrate it, also has the effect of forming a buffer. This reservoir of higher pressure air can act to dampen pressure and velocity fluctuations.

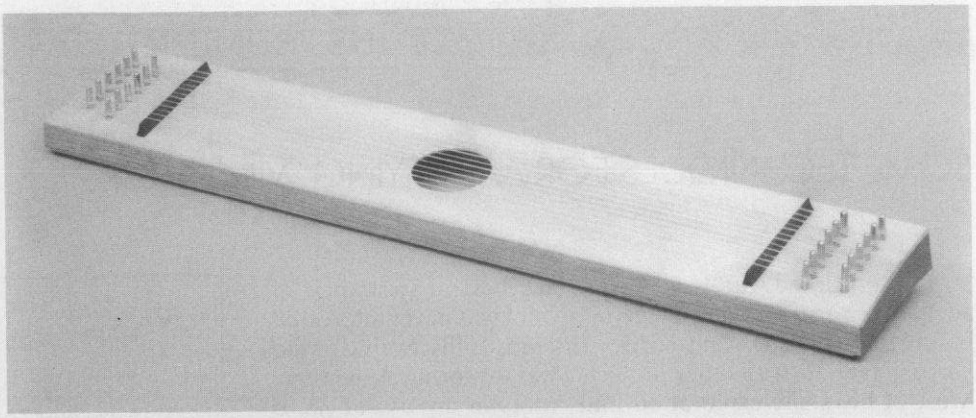
My favorite choice is a compromise. A good location is the corner of a building, with the harp mounted vertically. A mount can be easily rigged to allow: easy removal to inside storage, sure support at both ends of the harp, and ease of adjustment for wind direction and optimizing angle to the wind. There is not the limitation of window width either, and that fits with my growing inclination to lengths around a meter. In favor of the window mount though, it is an interesting experience to be thinking or

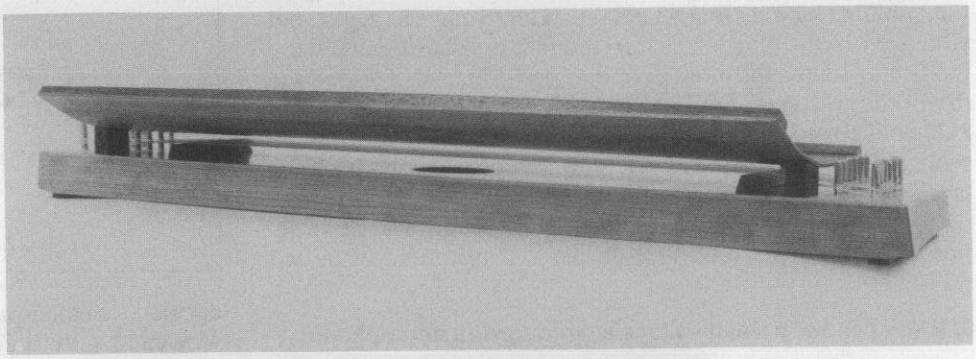
doing something in your house or wherever and have the low drone of the fundamental creep into your consciousness and suddenly realizing that you've been hearing it subliminally for some time previous. Having said all this, if the wind is available, there's nothing to beat the immediacy of standing out with the harp in your hands. Now that's fun.

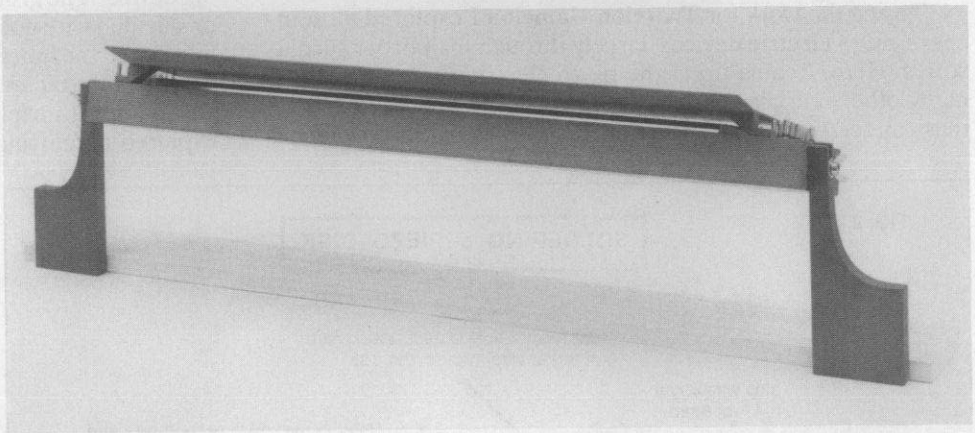
Maybe some of you are knowledgeable in recording musical instruments. It seems that it's difficult to record an aeolian harp without recording wind noise, especially a harp with no sound hole.

One last observation that's always interested me is people's appreciation for aeolian harps. While the vast majority are just captivated by the ethereal sound, about 3% of listeners seem to be bewildered that anyone might enjoy that noise. Here's to the 97% of us to whom that noise is bliss.

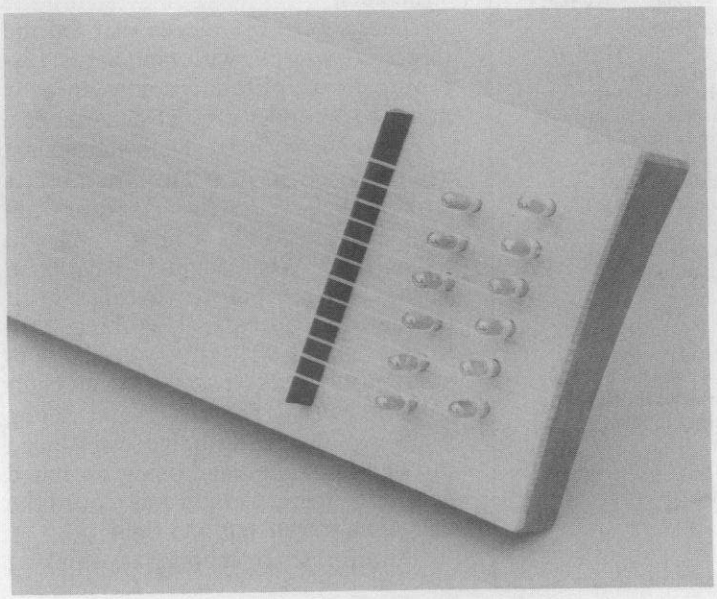
Tom Pearce has designed and built commissioned furniture for fifteen years in Denver. His business, along with Dave Boykin, is Boykin Pearce Associates. He can be reached at 1875 East 27th Ave., Denver, CO 80205-4527.

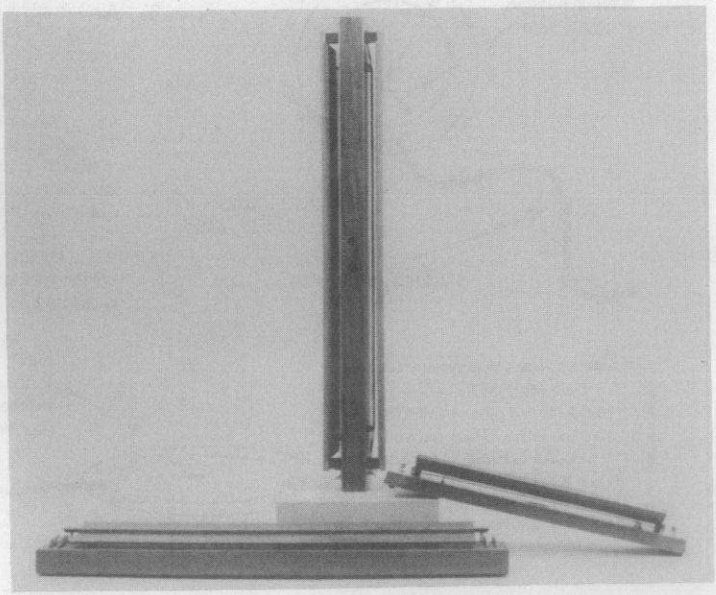






Photos: Aeolian harps by Tom Pearce. From top: Open-topped harp; harp with curved vane to direct wind over the strings; and harp with outdoor mounting, adjustable for wind angle. Below left and right: detail of the first harp shown above; and still life with 3 aeolian harps.





SOME TECHNIQUES FOR AMPLIFYING WIND HARPS

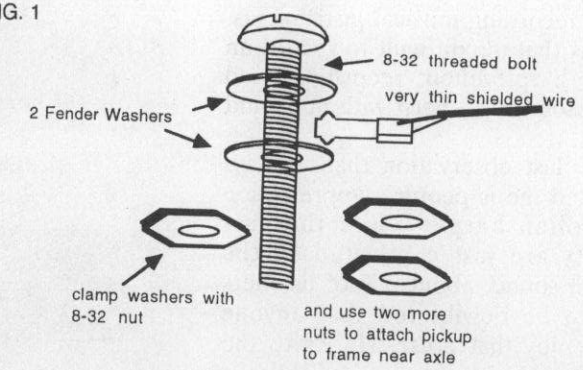
By Richard Lerman

I have worked with wind harps since 1981 or so. I knew of aeolian harps and singing kite strings, but I was never interested in creating acoustic wind harps. Instead, I 'discovered' wind harps in tandem with other projects I was exploring at the time. Most of my sonic exploration finds roots in my use of piezo electric devices since 1977. After composing **Travelon Gamelon** for amplified bicycles that year, I set about to make a rugged and effective pickup device, because the first pickups I made were too fragile to last for more than one performance. This led me to working with ceramic phono cartridges, which I mounted onto 8-32 bolts to attach to bicycles. (See Figure 1, drawing from the score to Travelon Gamelon.) These cartridges are made of two layers of piezo electric ceramic material that sandwich a thin piece of metal to form what is called a 'bi-morph.' The basic property of any piezo electric device is that it behaves in two ways:

1. If you bend it, a small voltage is produced (a microphone)
2. If you apply a voltage to it, the device bends (a loudspeaker)

During the work for **Travelon Gamelon** I explored all sources of piezo electric devices, largely through mail order surplus stores. Here, I came upon the piezo electric disc. To be sure, many other musicians and artists before me had worked with these materials. These devices are simply brass discs to which is epoxied a smaller piezo electric ceramic disc. A shielded audio wire can be attached directly from the disc to a pre-amplifier, and from there to an amplifier and speakers or a sound recording device. The ground wire always goes to the brass and the hot or shielded wire goes to the ceramic. They are the ideal material to explore the 'micro'phonic world. They are rugged and inexpensive. (see Figure 2)

FIG. 1



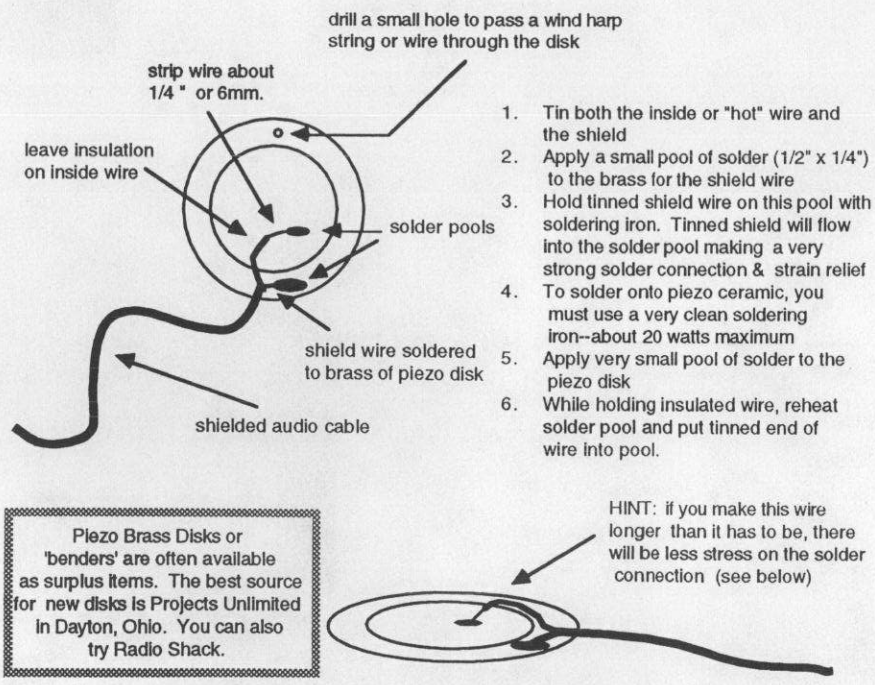
Along with exploring pitch inside of bicycle spokes, I also explored amplifying voices sung into plastic cups which were attached to harpsichord wire amplified by piezo electric discs (in my piece **Accretion Disk, Event Horizon, Singularity**, in 1978). I used tuning forks suspended from harpsichord wire (in my theater piece, **Incident at 3 Mile Island**, 1980), and some early installation pieces included amplified brass, bronze and copper window screens. Because of their sonic richness, I still work with these instruments.

These were the pieces that led me directly to working with wind harps. Listening to amplifed window screens mounted outdoors, through headphones, one could hear the mesh moving against itself, one could hear airborne objects striking the screens (insects, dust, rain etc.) and one could hear a rising and falling tone. What ought to have been obvious to me before revealed itself through the process of working: THE STRING FROM WHICH A SCREEN WAS SUSPENDED WAS ALSO BEING PLAYED BY THE WIND. The rising and falling pitch was the string being transduced through the metal, and being stretched and unstretched as the wind moved the screen up, down, left and right.

As a former trombonist my thinking

FIG. 2

SOLDERING a PIEZO DISK

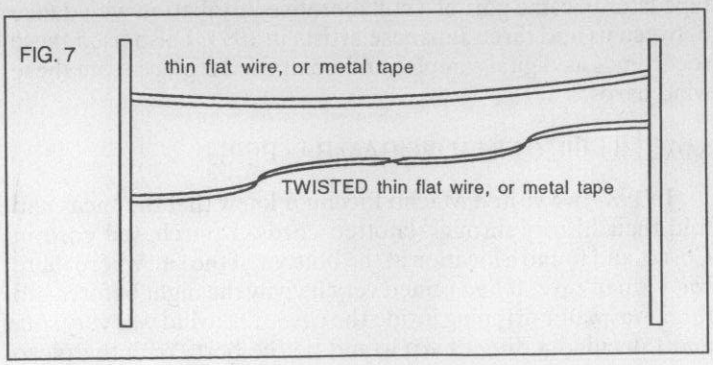


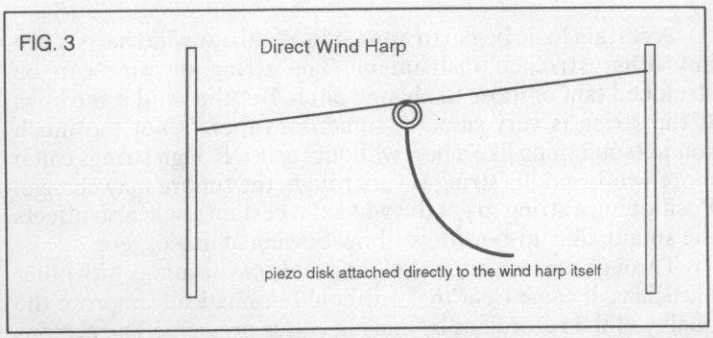
turned to ways I could use the harmonic series, also present in the string, to improve and change the sounds of these harps. I also explored using many different kinds of materials to construct these instruments: carpet thread, cotton, dental floss, nylon cord, ribbons, thin brass strips, twisted thin brass strips, bamboo strips, and other materials.

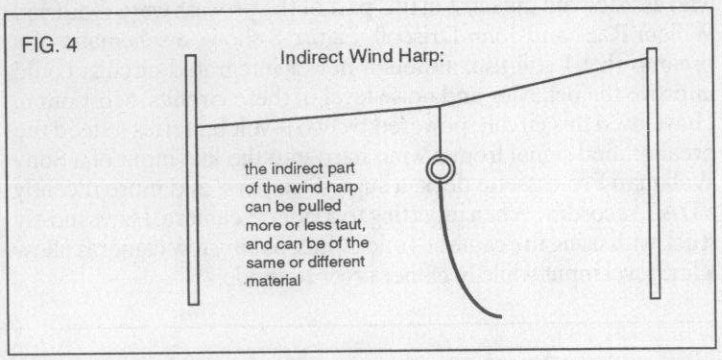
My setup was always basic. I would locate a site I wished to record in, decide upon the wind harp or microphonic material, mount a piezo disk and then record using a Sony walkman Pro or a Canon Super 8 camera. I began to categorize, in a loosely knit way, the kinds of wind harps I was working with. The following table and Figures # 3-6 illustrate these.

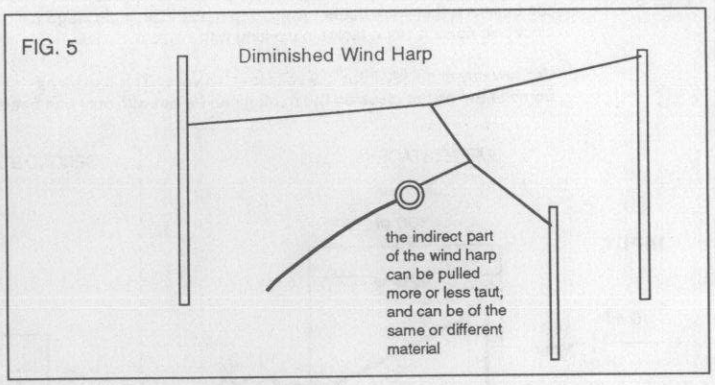
DIRECT WIND HARPS	Piezo disk attached directly to the wind harp string
INDIRECT WIND HARPS	Piezo disk attached to a second string which is attached to the wind harp string. These second strings can have a great influence on the wind harp, depending where it is attached on the main string. Attaching at harmonic nodes produces great results.
"AUGMENTED" WIND HARPS	Piezo disk attached to a third string, which is attached to a second string which is attached to the wind harp string – again harmonic nodes make for great results.
"DIMINISHED" WIND HARPS	Wind harp attached to a tree or object. Piezo disk is attached directly or indirectly to wind harp string or attached to the tree or object.

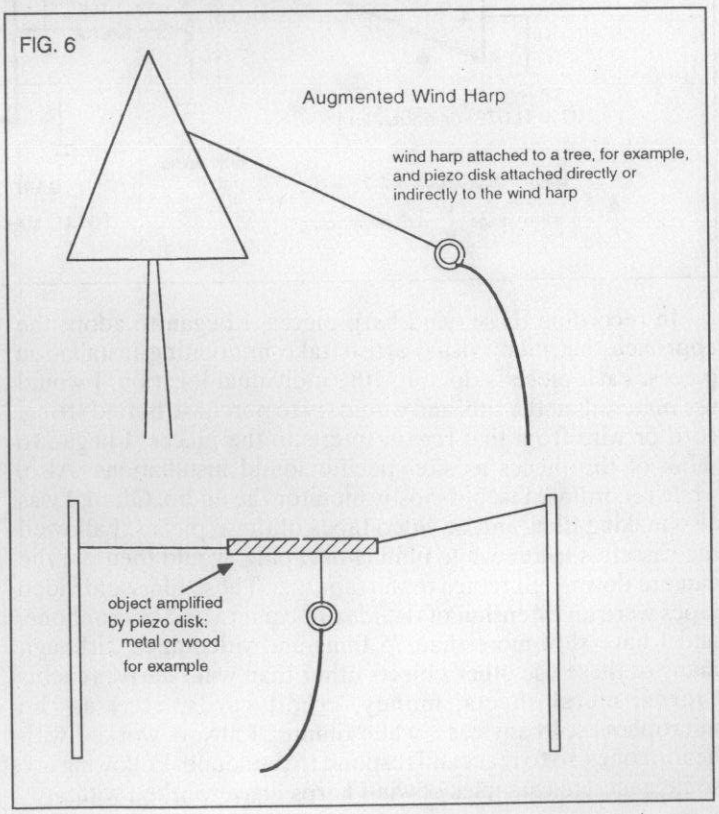
The above 'catalog' (while not complete) is one way I have approached working with wind harps. I had also experimented with using different strings and wires attached to each other. Obviously, a primary wind harp string made from harpsichord wire versus nylon twine will produce different sounds. Also, if the piezo disk of a secondary wind harp is attached to a nylon cord, which is attached to a long wire wind harp string, one will get different timbres if the order is reversed (the piezo disk of a secondary wind harps attached to a wire, which is attached to a long nylon cord wind harp string). Another technique, referred to earlier in this article, included using long and flat metallic wires (purchased at surplus stores). When twisted, different timbres emerged than if the wire was left simply flat. The wire wind harp string twisting in the wind actually becomes longer and shorter, and this creates doppler shifts inside the wire. In electronic terms, it's a phase shifter (see Figure 7).









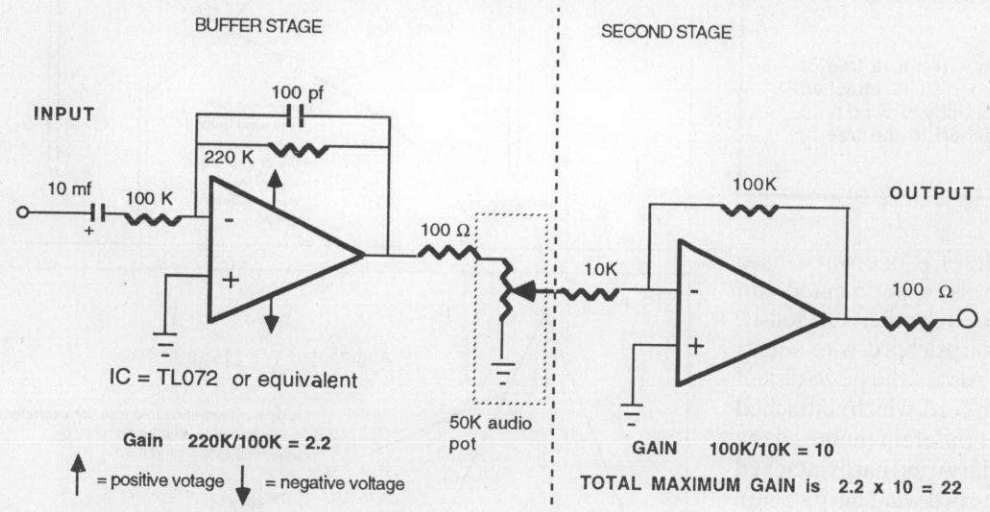


A certain logic began to appear in all this: A wind harp is like any other stringed instrument. The string or wire can be stretched taut or loose to change pitch. But the wind is the bow. If the string is very smooth, sometimes there's not too much sound (something like a bow without rosin). Rough strings catch more wind, and if a string is very rough, the timbre may change. Positioning a string to get the wind at a certain angle also affects the sound, like up-bow/down-bow/bowing at angles, etc.

Through my own circuit building and conversations with other musicians, it came clear that one could dramatically improve the quality of the recordings by making better preamps. The persons who assisted me the most in this part of the process were Godfried Willem Raes and John Driscoll. Figure 8 shows a schematic of a preamp that I still use, although newer integrated circuits could improve the behavior and noise level of these circuits. Most often, I have used this circuit, powered by two 9-volt batteries to feed the preamplified signal from a wind harp into the line input of a Sony Walkman Pro cassette deck, a super 8 camera, and more recently a DAT recorder. When inputting to a video 8 camera, I have mostly stuck with using the camera's mic inputs, as very few cameras allow a line level input while in camera record mode.

FIG. 8 This is a good, and quiet preamp for any piezo disk applications. There are other variations and combinations that work better. A preamp made in a single stage will be quieter, but usually, electronic noise is not a factor in working with Piezo materials.

Use any power supply from ±9 volts to ± 18 volts. This can be run from two 9 volt batteries. Some of the newer chips on the market can be run with only one battery. Explore.



In recording these wind harp pieces, I began to adopt the approach that many visual artists take in creating installation pieces: each piece is done for the individual location. I would use materials at the site, and would try to purchase or find string, cord or wire from that region to create the pieces. I began to think of the pieces as site-specific sound installations. Also, while recording, I would mostly monitor the audio. Often, I was also making films and/or video tapes of these pieces. I allowed the cassettes to run while filming or taping, would then put the camera down, and return to the tape ..... These films and video tapes were an extension of the idea of camera and microphone, and I have shot more than 75 films and videotapes, although many of these use other objects other than wind harps, (cactus thorns, metal sheets, money, credit cards, etc.) as the microphones. In any case, while filming, I always worked with headphones, so to react and respond to the sound. Following are some concrete examples of wind harps I have worked with.

ST. JOHNS, NEWFOUNDLAND

In Newfoundland, at the 1986 Sound Symposium, I was a guest at the home of Isabella St. John and Paul Steffler. Their home was right on the water's edge near the mouth to the harbor. I set up an installation there consisting of 2 very long secondary wind harps, which were at right angles to each other, to record the shifting wind direction. The nylon cord wind harp strings for this wind harp were tied to float above the grass and weeds. But, at times, I also attached amplified window screens (about 2 ft x 3 ft). The wind was very strong, and when the screens were attached, it caused the structure to move up and down, often violently. This allowed the grass and weeds, also blowing in the wind, to strike the cord – making a percussive sound not unlike *collegno batutto,* or tapping a string instrument with the wood of the bow.

That week, it also rained off and on (mostly on – it was a cold, damp summer), and as the rain began slowly, I could hear occasional rain drops striking the wind harp string. These sounds varied in timbre depending upon where each drop struck the wind harp. Both strings had a different pitch, and that pitch mostly stayed the same as each drop struck. The big surprise though occurred whenever a drop struck a harmonic node of a string – the sound changed in timbre, and seemed to reverberate a bit. It was like hammering a finger on the node of a stringed instrument. Finally, I could also hear metallic pings when a drop struck the piezo disk itself.

TOKYO, JAPAN

In 1989, while in Tokyo, my wife, Mona Higuchi was working on a series of rubbings from some of the stones at the Tokugawa Emperor's Women's Grave. I constructed two wind harps at the site, which were anchored by some of the pine trees. The harps were indirect, and one of them was amplified by having the piezo disk and wire coiled around one of the wind harp strings about twelve times. This damped that string (something like a mute on the bridge of an instrument). The piezo disk hung free, and I had soldered small pieces of harpsichord wire to the disk, that also behaved like many other strings in the wind. The harps were recorded using a video 8 camera with stereo audio. This video tape later became part of a collaborative installation with dance between us and three Japanese artists in 1991. I also used these recordings as digital samples and composed a piece from these wind harps.

MACHU PICCHU, URUBAMBA, PERU

In 1987, we visited Machu Picchu. I knew that the Incas had told their history through knotted cords. I purchased cord in Cusco, and found a location at the bottom of the site where there was a small cave. It had rained very heavily the night before, and there was water dripping inside the cave. The wind was very still, and I decided a direct harp would be the best. With the piezo

disk anchored inside the cave, and extending out about fifteen feet, the wind harp string picked up occasional sighing wind sounds along with the drips inside the cave.

MANZANAR, near LONE PINE, CALIFORNIA

The site of one of the Japanese-American internment camps during World War II, which we visited in 1994 to research a collaborative installation on one of the stranger ironies in history: the concentration camp Dachau was liberated by Japanese-American soldiers whose families were being interned at the same time in the US. Wind harps were set up in two locations. The first had been an old orchard, planted by the internees, which had now become completely wild – the indirect harps went from the trees down to the ground. The seond harps were from two vertical poles which were set in slabs of concrete. I tied the harps very tightly here, making one direct and one indirect. Manzanar is very near the same range as is Mt. Whitney, and I videotaped and recorded the beauty of the mountains while recording the howling winds.

Since 1987, working with wind harps as instruments has lead me to amplifying and recording objects directly, including leaves of palm trees, tops of pine trees, cactus thorns, fields of grass, stems of desert bushes, rocks, salt flats, and spider webs (although I am still not pleased with the results from the webs). There is a conceptual leap here. Everything is a wind harp. A wind harp needs to be anchored in two places, so it can be bowed by the wind. But a cactus thorn, for example, anchored at one end, is stiff enough to behave like wind harp. The wind, if it is strong enough, will bow the sharp instrument. We just need a way to listen to it.

In collecting all of this material, I finally faced the task of editing it. I began to compile the material I wanted to release onto 1/4" tape, and fortunately for me (and others) digital audio editing came of age. Many of the pieces I have recorded since 1984 are now on a CD called, **Within Earreach: Sonic Journeys** on the Artifact label. (All the pieces above except the one recorded at Manzanar are contained on this CD.) For about 1 ½ years I wrestled with the proper way of structuring these pieces. I finally decided on a kind of sonic order in which 3-5 pieces would be grouped together making a single piece.

As I have extended this work into the visual media of film, video and installation, I have also made two desktop or one-of-a-kind CDs for use in performance. Here the CD of the many individual sound files is played through speakers, and picked up again through self-built microphones, put through a cassette tape delay, and at times, a pitch to MIDI converter. The resulting performance will use as its form geographical location, timbral similarities, chronological order, or other structural devices.

I have always felt that the investigative process of making art can provide the driving force that leads to finished work. When I first began to record and film wind harps, I had no idea it would take me this far, or that it would take so long to complete, or that I would even complete anything from my investigations. I am also certain that others following similar investigations will arrive sonic places I will never reach.

The CD **WITHIN EARREACH: SONIC JOURNEYS**, and more complete schematics,diagrams and scores are available from Frog Peak, a Composer's Collective: Box 1052, Lebanon, NH 03766. (See the review of this CD in this issue of Experimental Musical Instruments.

Richard Lerman has worked in the area of electronic music since 1963. He has presented his work in North and South America, Europe, Southeast Asia, Australia and New Zealand. He now teaches at Arizona State University in the area of interdisciplinary performance.
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NATURE SOUNDS RECORDING AND USE

by Catherine Girardeau

This article is the second in a series appearing in Experimental Musical Instruments *on nature sound in music. The first, in which Barton and Priscilla McLean of McLean mix talked about their work, appeared in EMI's last issue. In the article following here, Catherine Girardeau reflects on current activity in the field, and provides a resource list of nature sound organizations, periodicals and libraries. Catherine's article is followed by another artist's report, as recordist and composer Douglas Quin talks about nature sound recording in the Amazon. Finally, in the next issue, René van Peer will give us a review and guide to available nature sound cassettes and CDs.*

This article is not a comprehensive guide to the recording and use of nature sounds, but hopefully will offer insight and resources for composers. In this article, museum curator Paul Matzner comments on the current popularity of using natural sounds in music as seen in the requests for sounds that come into the Oakland Museum's California Library of Natural Sounds. Bernard L. Krause discusses the recording and use of natural sounds in music as a convergence of artistic and scientific work.

"There's an explosion of interest in natural sound among musicians," said Paul Matzner, "judging from the number of phone calls we get at the California Library of Natural Sounds." Matzner is founder and chairman of the Nature Sounds Society and curator of the California Library of Natural Sounds (CLNS) at the Oakland Museum. The library is a comprehensive collection of recordings of California species sounds and ambient natural environments.

Matzner believes there's a trend toward musicians and composers grounding their work in natural sound and ecology. Although Matzner doesn't profess to be an expert in musical trends, he hears from plenty of composers at the CLNS. More than half the total requests for sounds in the last year have been from people working in some field of the creative arts. Matzner has his own explanation for this. He calls the ecology movement "the philosophical Zeitgeist of the '90s." He feels the increased interest in nature sounds is partly due to a higher degree of public awareness of the interconnections of species, not just from a scientific point of view, but on an emotional and philosophical level. There may be aesthetic reasons as well. "Many of the composers who call the CLNS in search of natural sounds for composition are coming to the conclusion that using sounds in context with the environment in which they occur makes musical sense," Matzner said.

Matzner said in the early 1980s, artists most often requested nature sounds to use as sound effects – either raw, or electronically manipulated through sampling or signal processing techniques. Because most nature sounds are complex sounds with sharp attack, or instantaneous peaks (quick rise of amplitude and decay), they make very good raw material for sampling. Biological accuracy, or the practice of using sounds within the context of their natural environments, while important to scientists and museum curators, wasn't necessarily important to artists using nature sounds.

Matzner contends that trend is changing. Many composers now are interested in re-creating a sound environment in context, Matzner said. "When you talk about 'biological accuracy,' it's about 'sense of place.' If the Zeitgeist of today is an awareness of our 'sense of place' on the planet, it becomes important for composers to create a sense of place in their work." Matzner said many composers who request sounds from the CLNS are striving for an understanding of nature sounds that goes beyond their meaning to the work as compositional elements. In fact, it may be important musically to understand how sounds relate to the ecological fabric in which they're heard, and how they synchronize to create the music of nature.

Many composers who use nature sounds are also involved in the environmental movement, and are inspired to use nature sounds in part by their concerns about environmental degradation. Priscilla and Barton McLean mention this in their article, "The McLean Mix Muses Upon the Ultimate Musical Instrument" in the September 1994 issue of EMI.

However, as do many composers who work with nature sounds, the McLeans are not necessarily using nature sounds to further an environmental issues agenda – they speak of nature sounds in musical terms. In their article, the McLeans refer to, "an astounding loon oratorio." Nature sounds composer and recordist Jonathan Storm (whose recordings are out on the Earth Tunes label), refers to, "a symphony of thunder" in the liner notes to one of his recordings.

Nature sounds are central to much of the work of composer and recordist Douglas Quin, based in Rockville, Maryland. Quin combines synthesized and digitally processed human and animal voices with natural sounds to create sonorous, multi-layered works in which his musical compositions parallel the chirps and songs of birds and other animals.

Quin and other musicians performed some of his music in June at the Oakland Museum as part of an ongoing natural sound concert series called "Music With Birds, Frogs and Other Creatures." In Quin's "Yasashii Kaze" (Gentle Wind), the clarinet plays transcribed bird calls against ambient natural sound beds. Quin uses natural phenomena as "maps", or structure, for some of his compositions. In "Kingdoms and Phyla, Part 5", Quin used a schematic diagram of a glacial flow as the "score" followed by improvising musicians. San Francisco State University geologist Ray Pestrong has drawn a line along the silhouette tops of mountains and used it as a musical score.

Natural sounds from the CLNS are not just used in "new music" – museum exhibit designers; film, video and multimedia sound designers; television and radio producers; and even people working in psychology and medicine use sounds from the library in their work. Psychoacoustics is a relatively new field in which people study the psychological effects of sound and/or use

sound to produce desired psychological effects. A quick trip to any major record store will show you there's a market, if not a genuine need, for recordings that help people get away from the noise of everyday urban life and escape into the music of nature. The use of nature sounds in "relaxation" tapes is common. Nature sounds are used to escape from or mask the sounds of the urban world, as well as to re-connect with the natural world.

Paul Matzner doesn't insist on biological accuracy in artists' use of nature sounds, despite his academic background in biology and his work as curator within the natural sciences department at the Oakland Museum. The CLNS is a resource center for people to listen to, learn about, and gain access to natural sounds to use in their work, but, Matzner said, the library considers any creative use of natural sounds valid.

"The interrelationships in nature, the gossamer webs of detail are the things that make sense, and they can't be quantified. Western science doesn't understand that which can't be quantified," said Bernard Krause. In his article "Tuning in to Nature" published in the March/April 1992 issue of *Earthwatch Magazine*, Krause says nineteenth century scientific research tended to focus on the study of single species in an attempt to understand the individual in its larger context. Despite improvements in recording technology in the late 1960s which allowed researchers in the new field of bioacoustics (bio = life, acoustics = sound) to begin to record sounds within, rather than isolated from, their environment, many researchers continue to isolate single species. Krause himself, a musician, composer, sound designer, and recordist with a Ph.D. in creative arts and bioacoustics, takes a different approach.

Krause made his violin debut with the Detroit Symphony at age 4. His performing and recording experience includes a stint with the Weavers, and on the 1968 Moog synthesizer recording, *The Nonesuch Guide to Electronic Music*. Krause has recorded over forty albums of his own music on his company's label, Wild Sanctuary. Krause said his 1969 album, "In a Wild Sanctuary," produced by Warner Brothers, was the first commercial recording to incorporate nature sounds and original music.

Krause began to develop his "Niche Hypothesis" doing field recording in Africa in the 1980s. In the aforementioned article, Krause writes that like most scientists, he had been trained to listen for individual sounds so he could locate and identify them. But during his extensive time listening in the field, (Krause typically spends 500 hours on site to get 15 minutes of usable material, a ratio of 2000 to 1), he said he began to understand and hear natural sounds in their context as an orchestra. In his June 1993 article, "The Niche Hypothesis" (Soundscape Newsletter #6, The World Soundscape Project, Simon Fraser University), he describes the niche hypothesis thus: Each species has its own sonic niche or channel in which to vocalize, and each vocalizes in a way that is perfectly harmonious with the other voices in that environment. Krause has tested this hypothesis extensively by measuring audio bio-spectra. An audio bio-spectrum is an acoustical spectrographic mapping of a habitat in terms of frequency and amplitude over short periods of time.

The niche hypothesis suggests that the orchestra of animal voices within a given natural environment sends out a clear acoustical message about that habitat's biological health – a message that can't be heard in the isolated voice of a song bird. "The keys to our musical past and the origins of complex intra-species connection can be learned from the acoustic output of unaltered habitats," Krause writes.

Most readers will agree that habitat conservation is crucial to the continued survival of the planet. It's also crucial to the understanding of environments in all their complexity. Wild Sanctuary's library consists of more than 2,500 hours of material, 20% of it from now-extinct habitats. Recordists around the globe have documented the disappearance of quiet places in which to record. Recorded documentation gathered by the Nature Sounds Society and by individual natural sound recordists are earwitness to the dramatically reduced periods of time in which uninterrupted ambient natural sound exists. Aircraft, roads and mechanical noise intrude into even the most remote places left in the world.

Apart from the scarcity of quiet places in which to record, there are technical issues in nature sound recording. Krause said the whole idea of recording natural sounds is to give listeners a sense of what that environment sounds like. But the act of recording by definition takes the sounds out of context. The equipment and microphones used record a less-than-accurate picture of the actual sounds. Even when using sophisticated binaural recording equipment such as the binaural head recordist/composer Gordon Hempton and others use, the sounds are usually transferred to a stereo medium for listeners: a complete alteration of the original recording. Krause said it's very important to create a new context which gives the listener a sense of being where the sounds were recorded. To do that, you must "compose" the sounds. The artistry is composing with natural sound to create the illusion of place.

Krause has used multi-tracking in combination with his niche hypothesis to re-create sonic environments. For example, his "Amazon Days, Amazon Nights" album was mixed from 170 tracks, with each track being a sonic niche occupied by certain species. Some composers' work is closer to what John Cage called "found composition," in which the recording is not processed or multi-tracked, but instead left in its "original" state. However, aesthetic decisions must be made throughout the process of recording and producing natural sound compositions: where and when and with what equipment to record, which segments to include or not to include in the final edit, and how to juxtapose sections of the recording in a finished piece. To say these are not musical compositions would be to deny John Cage's understanding of accidental conjunctions of sound as music.

The best introduction to music using nature sounds is, of course, to listen for yourself – to recordings, and most of all, to actual quiet places. To contact the Nature Sounds Society and the California Library of Natural Sounds, write Nature Sounds Society, Oakland Museum, Natural Sciences Department, 1000 Oak Street, Oakland, CA 94607, or call 510/238-7482. To contact Bernard L. Krause, write Wild Sanctuary Communications, 1302 Henro Rd., Glen Ellen, CA 95442.

(Turn to next page for resource list)

Catherine Girardeau is a radio producer and writer in San Francisco.

Nature Sound Recording & Use:

RESOURCE LIST

NATURE SOUNDS SOCIETY

Oakland Museum, Natural Sciences Department, 1000 Oak Street Oakland, CA 94607 510/238-7482. Chair: Paul Matzner. Publication: **Nature Sounds** (quarterly newsletter)

Nature Sounds Society Mission Statement: The Nature Sounds Society is a world-wide organization whose principal purpose is to encourage the preservation, appreciation and creative use of natural sounds. The Society promotes education on the technological, scientific and aesthetic aspects of nature sounds through its programs and a diverse network of contacts.

WORLD FORUM FOR ACOUSTIC ECOLOGY

Dept. of Communication, Simon Fraser University, Burnaby, B.C., Canada, V5A 1S6; Fax: 604-291-4024. Publication: **The Soundscape Newsletter**

The WFAE was formed August 13, 1993 at the conclusion of the Tuning of the World conference at Banff Centre for the Arts. From the WFAE's brochure: "The World Forum for Acoustic Ecology (WFAE) is an international interdisciplinary coalition of individuals and institutions concerned with the state of the world soundscape as an ecological entity. Acoustic Ecology is the study of the relationship between living organisms and their sonic environment or soundscape. WFAE's main task is to draw attention to unhealthy imbalances in this relationship, to improve the acoustic quality of a place wherever possible, and to preserve acoustically balanced soundscapes.

SOUND LIBRARIES

CALIFORNIA LIBRARY OF NATURAL SOUNDS

Oakland Museum, Natural Sciences Department, 1000 Oak Street, Oakland, CA 94607; phone 510/238-7482. Curator: Paul Matzner.

LIBRARY OF NATURAL SOUNDS

Laboratory of Ornithology, Cornell University, 159 Sapsucker Woods Road Ithaca, NY 14850. Phone 607/254-2406, fax: 607/254-2415. Curator: Greg Budney.

THE BIOACOUSTIC ARCHIVES

Florida State Museum, University of Florida, Gainesville, FL 32611. Curator: Dr. J.W. Hardy.

BORRER LIBRARY OF BIOACOUSTICS

Dept. of Zoology, Ohio State University, 1735 Neil Avenue, Columbus, OH 43210-1293.

BRITISH LIBRARY OF WILDLIFE SOUNDS

British Institute of Recorded Sound, 29 Exhibition Road, London, SW 7 2AS (Ron Kettle).

MUSEO DE ZOOLIGIA

Apartato de Correus 593, Barcelona, Spain 08037 (Dr. Anna Omedes)

RECORDING WORKSHOPS

Both the Cornell Laboratory of Ornithology and the Nature Sounds Society offer field recording workshops at the San Francisco State University's Sierra Nevada Field Station at Yuba Pass in mid to late June. The NSS workshop is 3-4 days. It is open to beginners, amateurs and professional nature sound recordists, and typically attracts a diverse group of artists, musicians, biologists, ornithologists, and amateur birders. Guest speakers have included The McLean Mix (see September 1994 EMI), Douglas Quin, Catherine Stifter of National Public Radio, and many others. Dawn chorus recording, technical workshops, and much more.

For information on Cornell's workshop, call 607/254-2406. The Cornell workshop is focused on bird identification and biological study.

– C.G.

FOR PAUL PANHUYSEN
On his 60th Birthday, August 21, 1994

By Douglas Quin

WWF Camp KM 41, Amazonas, Brazil

Hissing beacons from gas lamps and flickering candlelight yawn across the camp clearing; shadows of ropes and hammocks undulate gently along the exposed rafters of our shelter. There are no walls, just posts supporting a corrugated tin roof, beams for hanging hammocks and gear, a few worn benches and fruit box shelving. The sand floor is swept clean and a low berm circumscribes the structure, diverting periodic rivulets that wash through camp when it rains. The forest is drawn around us like a curtain. Tiny eyes cast green, blue and orange glances and stars penetrate the canopy like shimmering tesserae.

Voices and volleys of laughter from the covered kitchen rise over a groove of insects and snores from the other sleepers. A vociferous botany graduate student, whom the staff has crowned a boca de noite, holds court to a clutch of card players: another scientist, the relief cook and the project drivers, who arrived with provisions from Manaus in the afternoon. "The mouth of the night" is a thick-legged, raven-haired Brazilian woman in her middle twenties. She has been here for several months and maintains a proprietary aloofness when dealing with short-timers like myself. Her samples are carefully pressed in newspaper and bound in numbered, lath volumes. The spiral notebooks are swollen with dampness and faded pencil notations. In a few days, she will leave the forest and her data will begin to coalesce into an opinion.

She has come to study floral opportunism in treefall areas – one site in particular. In an old-growth forest, the death of a large tree and the real estate cleared in the ensuing fall create opportunities for other plants to move in. The competition is intense; specialization and strategies for success are varied, complex and elegant. The study is but one aspect of a long-term undertaking designed to broaden our perception of rainforest dynamics and the effects of fragmentation. The Minimum Critical Size of Ecosystems Project is jointly managed by the World Wildlife Fund (WWF) and the National Institute for Amazon Research (INPA). After more than a decade of research, findings seem to indicate that large, contiguous areas of healthy rainforest are necessary for sustaining biological diversity. Scientists from all over the world pass through Camp Km 41. The breadth of investigations, combined with a richness of insight from diverse personalities, encourage lively discussions and a congenial atmosphere.

Botanists don't get up early... A *boca* booms, the cards are shuffled, another round is poured and moths are compelled to the light. The night slips into a humid chill and I curl into my hammock. I will head out in a few hours, with a small group led by British ornithologist and guide Andrew Whittaker, to record the dawn chorus. This trip will be unique in that we plan to situate ourselves at treetop level, on the platform of a meteorological survey tower. Unless by some geographic advantage, my previous work has been confined to the perpetual twilight of the forest floor.

At 2:30 am, after a few fitful hours of sleep, we shuffle through the compound to get a *cafezinho* – a cloying shot of coffee and sugar. The vehicle is parked about a kilometer's walk from the camp and

we set out. Our flashlights swing along the path according to the different strides. The driver is a wiry *caboclo* whose skills and infectious good humor are appreciated. Several coffees and a cigarette have soothed drunkenness to hangover; he is ready and we are off. With a good start, the hope is to be in position before sunrise. The road, even in the dry season, is a challenge. With the recent rains, fallen trees, mud and rills create an obstacle course for the better part of 50 km. The driver knows the nuances of the route – deftly using the Landcruiser's weight and momentum, as well the features of the road to his advantage.

Our destination is an observatory and balloon launch which was constructed by the American space agency, NASA, nearly 20 years ago to monitor Amazonian weather phenomena. Responsibility for the tower now rests with INPA, and permission for our visit was secured by Andrew before leaving Manaus. We arrive just shy of five o'clock and divide recording gear and morning supplies for the short hike in. It is still dark. The track has lapsed into disuse and a deep bed of leaves and encroaching undergrowth softens the breach into the forest. Up ahead, someone has surprised a preying mantis. The iridescent, green figure is the size of my hand. It stands motionless on attenuated legs. Then, the head pivots and the body vacillates, emulating the motion of a leaf disturbed by a breeze. We walk on and a clearing opens before us. The INPA Tower.

Flashlights yield a collage of the whole: a Tatlin-like lattice of footings, steps and a spidery, rusted framework. At the base I look up; as the tower tapers, stair treads telescope into a shoal of mist – 50 meters above. There are five of us and the climb is staggered to prevent the structure from swaying with our motion. Comforting thought... At the top, the platform itself is plate steel with a reticulated surface, open to the sky and measuring about eight meters square. We assemble in the coolness and wait for the tower to stop rocking, laughing nervously as Andrew reminds us to move about slowly – one at a time. I prepare my recording equipment for a wide stereo field, ask for quiet and we listen. Bats and insects occupy a broad, high frequency range of pulsing whistles and rasps. The moon eases into the horizon – dewy, yellow mandorla.

Constellations fade beneath an impressionist wash of first light – muted pinks and grays smear against the ebbing darkness. Equatorial transitions are quick. The sun rises and fog retreats like a veil being slowly pulled across an emerald sea. The swell, troughs and crests of the canopy hint at the lay of the land below. From our vantage above the forest, the drama of awakening unfolds. Our unspoken relief at the dawn is given voice by a group of howler monkeys, whose roaring thunders through the trees. The vocalization is a territorial display by a dominant male from a nearby troop, numbering about ten individuals. A series of long, low, hollow, howls cascades to a gurgling crescendo. Neighboring alpha males respond and a musical canon measures the extent of boundaries between groups. The black figures seem to float on frozen waves and macaws fly below us – leaving a wake in mist curling through the canopy. The soundscape fills in layers as the chorus is joined by parrots, toucans, fruitcrows, cotingas, cuckoos, and screaming pihas.

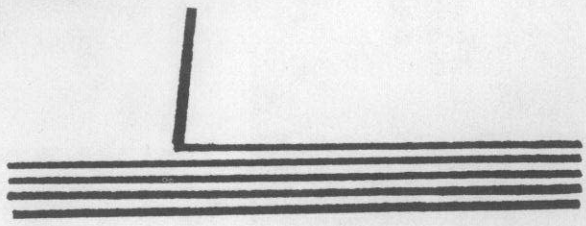
The forest is imbued with a primordial resonance: a feeling that sound itself is etched into the forms before us – the ravines, trees, vines and moist corridors. This acoustic imprint is what gives reverberation or echo its limitless embrace. From his cabin on Walden Pond, Henry David Thoreau suggested that, "All sound heard at the greatest possible distance produces one in the same effect, a vibration of the universal lyre, just as the intervening atmosphere makes a distant ridge of earth interesting to our eyes by the azure tint it imparts to it .... The echo is, to some extent, an original sound, and therein is the magic and charm of it. It is not merely a repetition of what was worth repeating ... but partly the voice of the wood."*

In selecting sites for ambient recording, I am challenged by topography: in terms of ascertaining acoustic characteristics of habitat and negotiating accessibility. In this case, the tower is a gift rather than a find. Discovery in listening more often assumes a form of personal geomancy: an empirical and intuitive process by which I place myself into receivership, as it were, within a landscape. Wildlife recordings are hard to "make", to "get" or to "take." A good recording of the "voice of the wood" is as much a revelation as it is an acquisition. The difference lies in attitude. The disposition of landscape, its features, surfaces and textures, the density of forest, relative humidity and air temperature all mold sound into a distinctive experience. Valleys in the rainforest can often be heard before they are seen. A dawn chorus is the affirmation and cyclical renewal of place. It is a mystical breath, heard as a flourish along a terrestrial meridian. As with the Chinese art of placement, feng shui, finding the right spot is a matter of paying attention to one's surroundings, alignment and juxtaposition.

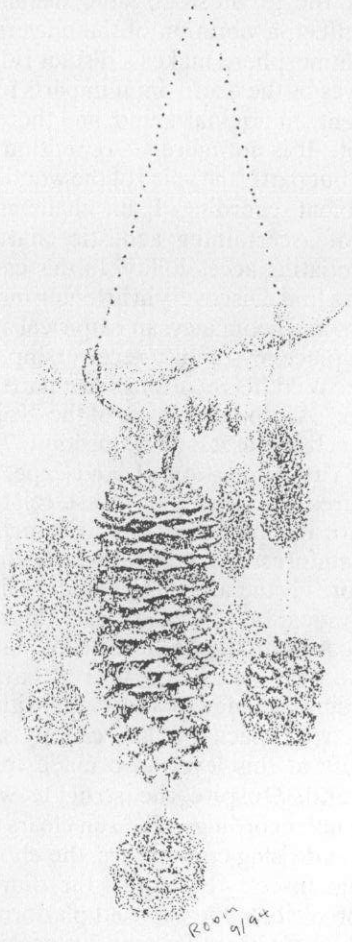
This morning, the reflective capacity of the canopy and the concentration of wildlife at this level have made for a unique immersion in sound. Despite the struggle with humidity, I am fortunate in my recording. The sun clears the trees. With mounting heat and rising convections, the chorus dissolves into a diffuse din. Insects reestablish the diurnal palette of timbres. By nine o'clock, the exposed platform is like a skillet and a dense cloud of biting flies sends us packing. In daylight, the descent seems more vertiginous. Flora and fauna alike change as we move from the higher reaches of the canopy, through the gallery and understorey, back to the ground. The sonic signature of each stratum is remarkably varied and would make an interesting study. We file back to the Landcruiser in silence, savoring the morning.

In the 4-hour run back to Manaus, talk turns to showers, cold beer and a restaurant specializing in Amazonian fish delicacies: *pirarucu, tucunare, cara-acu* and *tambaqui.*

Douglas Quin is a composer and wildlife recordist. His latest recording is Oropendola: Music by and from Birds (Apollo Records, Eindhoven, the Netherlands). His current project involves making soundscape recordings in the Antarctic and the Arctic. He can be reached at 5504 Besley Court, Rockville, MD 20851, and via E-mail at dquin@aol.com.



* Henry David Thoreau, **Walden: or Life in the Woods** (New York: New American Library/Signet, 1960), p. 87.



NATURAL WIND CHIMES

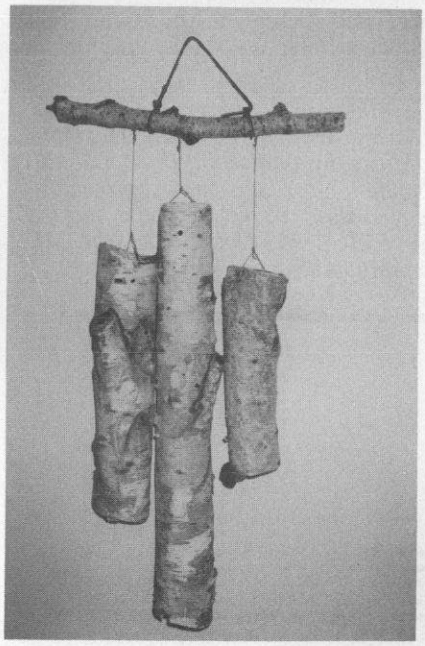
Instruments, photos and text by Steve Heitzeg

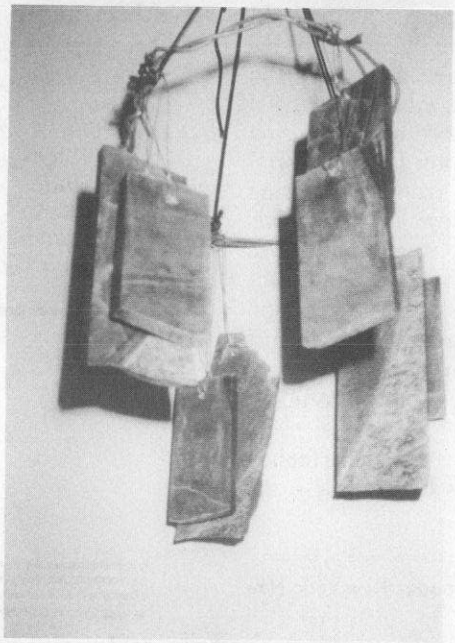
The following is excerpted from Steve Heitzeg's presentation "Music And Ecology: Toward A Geomusic" at the Annual Meeting of the Friends of Linnaeus Arboretum at Gustavus Adolphus College, Saint Peter, Minnesota, September 27, 1992.

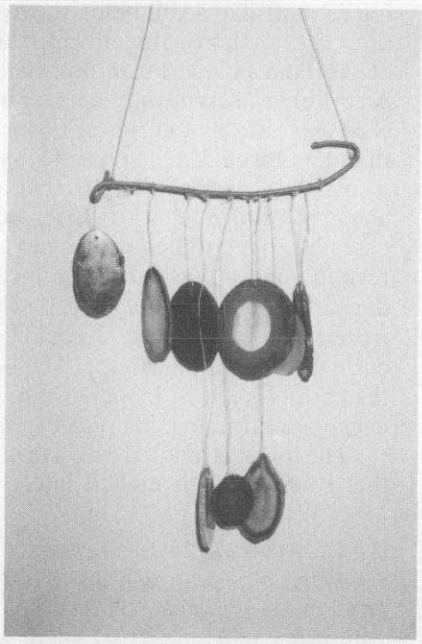
My mission as a composer and as a believer in music is to speak truthfully and to speak for peaceful coexistence through music. All musical instruments, including ourselves, have the same origin: Nature. All instruments come from and sound in nature...the wood of string instruments, the metals of brass and percussion instruments, just to name a few. Then, air – for the instruments to sound in and for music to transform us. Nature, then, is in all music. Music is in nature. Music is nature. Nature is music. We are born of nature. We are part of nature, not apart from nature. By including natural instruments (such as soil, bones, stones, leaves and rainsticks) with standard instruments in my own works, I hope to symbolize musically the "interconnectedness" of humans with each other and with nature.

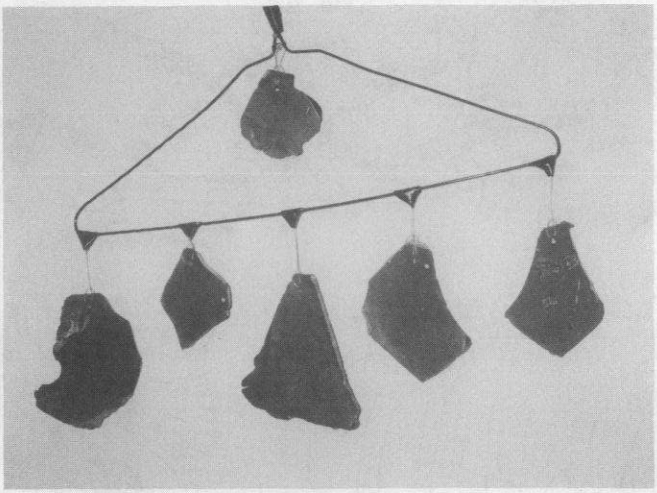
The role of the arts in society is this. When we listen to music, read poetry or prose, look at a work of visual art or participate in any such defined "artistic experience," we are taking time to hear, see and feel what another person has created – that is, felt or is feeling or essentially experienced. By so doing, we have placed ourselves in that person's world for an instant, an hour, or perhaps even a lifetime. The ultimate notion that is carried forth from this experience is an acceptance of that person's right to have their voice heard. This occurs in all styles of all the arts despite societal and institutional norms. It is this response of acceptance for not only other human's voices, but also for all lives that must occur if peace, justice and environmental mindfulness are to exist.

This, of course, brings us to the question as to whether or not humans are the only species on this earth who create music. I believe they are not. Humans have an "instinctual" need to relate their spirit and needs to others or to just "sound," which somehow places one in the world. To say that other species do not create music and that their voices merely act as instinctual drives for protection and mere survival is to negate our own natural and primal relations. A belief in nature, not just the nature that one takes walks in or enjoys when the weather is doing what you want it to, but a belief in nature that first, places you as an equal with nature and not as a superior







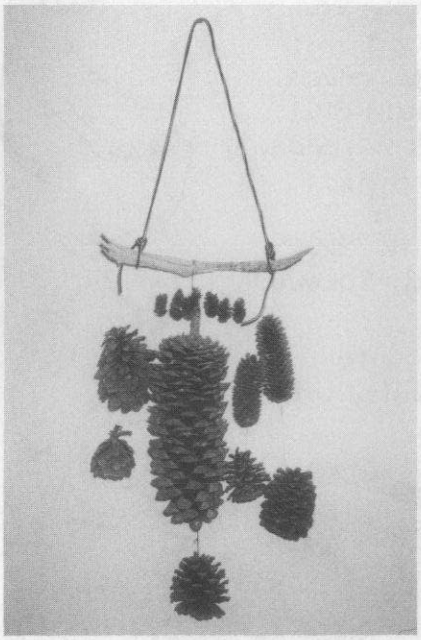


human who is here to use nature; second, that causes you to hear the voices of all beings in an unprejudiced and freeing way that is not "defined" by human structuring; and third, that creates a need in yourself to strive for the music of all beings to be heard, affirms your own existence and others' lives on this planet – you are with the music. To do such says yes to living and peaceful coexistence.

It is our turning away from others' music except our own (human, that is) that has brought about the past and current dilemmas – ecological and otherwise – on the earth. The Cartesian dictum "I think, therefore I am" has turned in upon itself. The duality and consequent division of mind and body, human and nature, intellect and feeling, sacred and profane, has taken us out of the green and blue music, the anthropomorphic and zoomorphic music, the aquatic and arboreal music. Music is green. It is blue. It is black, brown. It is all colors. It has no color. There is wind music, water music, insect music, plant music, human music, tree music, stone music, sky music; music lives in all beings. I ask you, rather the Earth asks each one of us, to listen for each other, to sing with each other.

Just as music is a remembered melody, voice or gesture, the Earth remembers. Each of us shapes and guides the earth as the earth shapes and guides us. We are all native to this earth and this is the origin of music -- chords of humanity, animal chants, oceanic and aquatic arias, mountainous percussion, insect inventions, passacaglias of plants, symphonies of sky. Each solitary and individualistic spirit and being is a sustaining note in this life, this music.

Steve Heitzeg is a composer of concert and film music and an adjunct member of the music faculty at the University of Saint Thomas, Saint Paul, MN.



PHOTOS, FROM FAR LEFT:

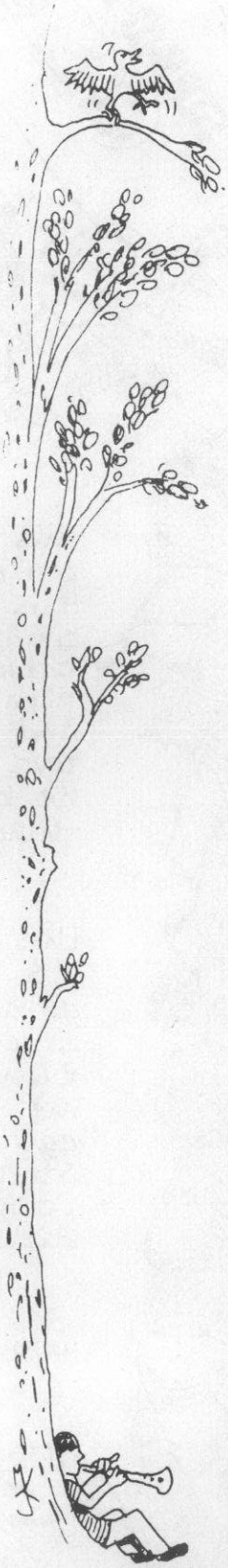
Birch Bark Wind Chime: fallen birch bark branches (hollow) and waxed string. The birch bark wind chimes, as well as the pine cone wind chimes also appearing on these pages, were made for and were played in Steve Heitzeg's **Raven and Crow: Medicine Birds**, commissioned and premiered by the New Music Ensemble **Zeitgeist**, Walker Art Center, Minneapolis, MN, May 23, 1993.

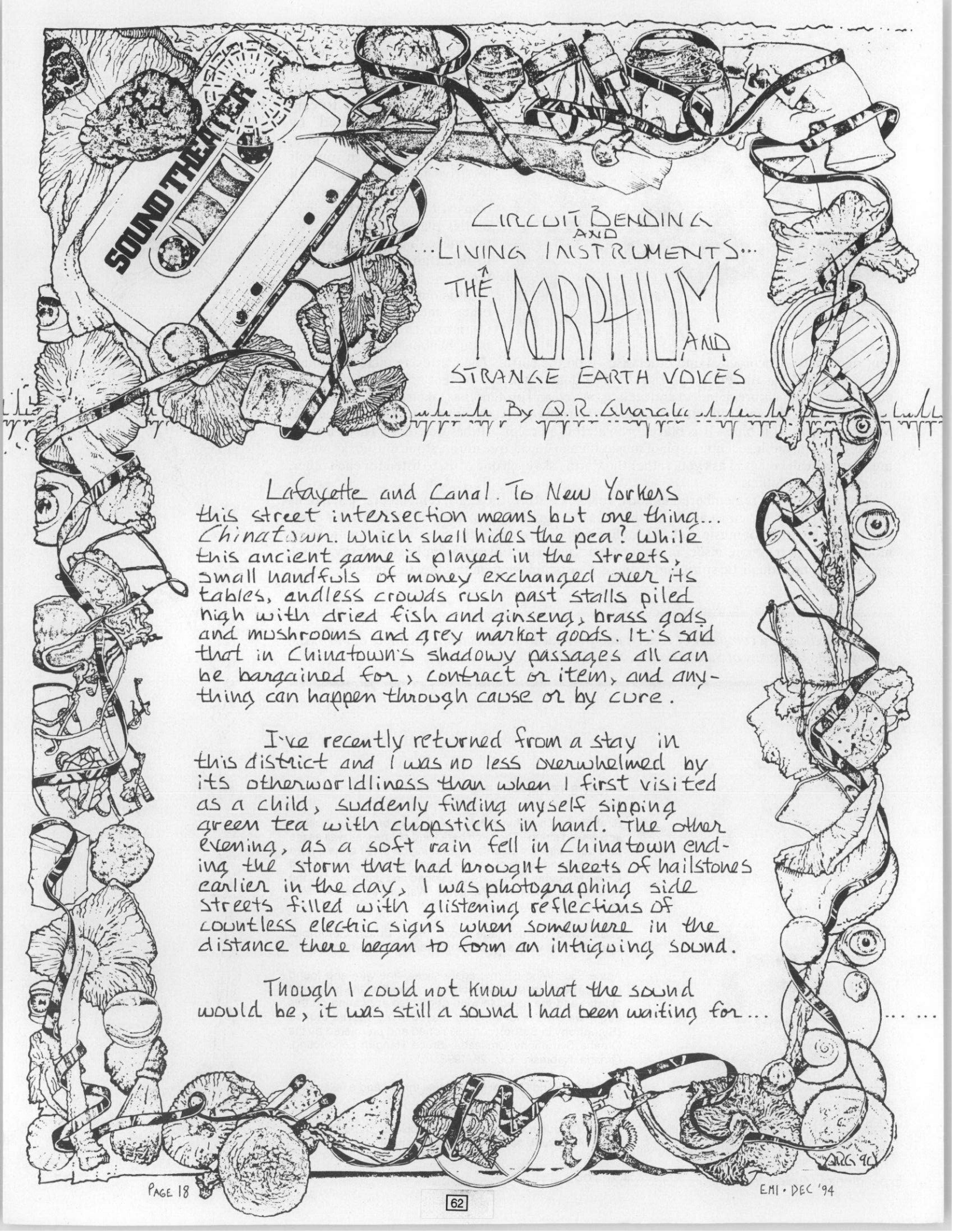
Jade Wind Chime: jade slices (from British Columbia, Canada), fine wire, silk cord and wrapped aluminum wire.

Agate Slice Wind Chime: agate slices, fine wire and found metal. The agate slice wind chimes, as well as the jade wind chimes and the obsidian wind gong also appearing on this page, were made for and were played in my **Sacred Stones (Symphony in Stone),** commissioned and premiered by the Omaha Symphony Orchestra, Bruce Hangen conducting, Omaha, Nebraska, Oct. 28, 1993.

Pine Cone Wind Chime: pine cones, thread and a fallen pine branch.

Above: Obsidian Wind Gong: black obsidian slabs, fine wire, black electrical tape and a wire coat hanger.





CIRCUIT BENDING AND ...LIVING INSTRUMENTS...

THE MORPHIUM AND STRANGE EARTH VOICES

By O.R. Ghariali

Lafayette and Canal. To New Yorkers this street intersection means but one thing... *Chinatown*. Which shell hides the pea? While this ancient game is played in the streets, small handfuls of money exchanged over its tables, endless crowds rush past stalls piled high with dried fish and ginseng, brass gods and mushrooms and grey market goods. It's said that in Chinatown's shadowy passages all can be bargained for, contract or item, and anything can happen through cause or by cure.

I've recently returned from a stay in this district and I was no less overwhelmed by its otherworldliness than when I first visited as a child, suddenly finding myself sipping green tea with chopsticks in hand. The other evening, as a soft rain fell in Chinatown ending the storm that had brought sheets of hailstones earlier in the day, I was photographing side streets filled with glistening reflections of countless electric signs when somewhere in the distance there began to form an intriguing sound.

Though I could not know what the sound would be, it was still a sound I had been waiting for...

THE MORPHIUM and Strange Earth Voices

by Q.R. Ghazala

(continued from previous page)

Not long prior to departing for New York, I finished a group of instruments I had been asked to build for the European experimental music group, Faust. The series of five instruments constructed for the '94 USA tour consisted of one standard Incantor, one custom Incantor, my new Trigon Incantor which is played by rolling heavy steel spheres upon a pressure-sensitive stage (Incantors are circuit-bent,* human-voice synthesizers. See EMI Volume VIII #6, June '93), and two circuit-bent sample banks, the more elaborate of which is the Morphium (see photo).

Regular readers of this series know that I'm fascinated by unusual sounds, their emotional impact often being very strong, very viable for composition. Actually, all planetary cultures are probably surrounded by unexplained noises. Certainly all tribes of this sphere have recorded in their histories event upon event of mysterious Earth voices. While some were deified and worshipped, others evoked dread and were demonized. Many of these noises rely upon simple modification or combination of veridical sounds (the operative basis of my Morphium instrument), and a few of the more renowned examples of these ethereal planetary voices might be of interest to the EMI audience.

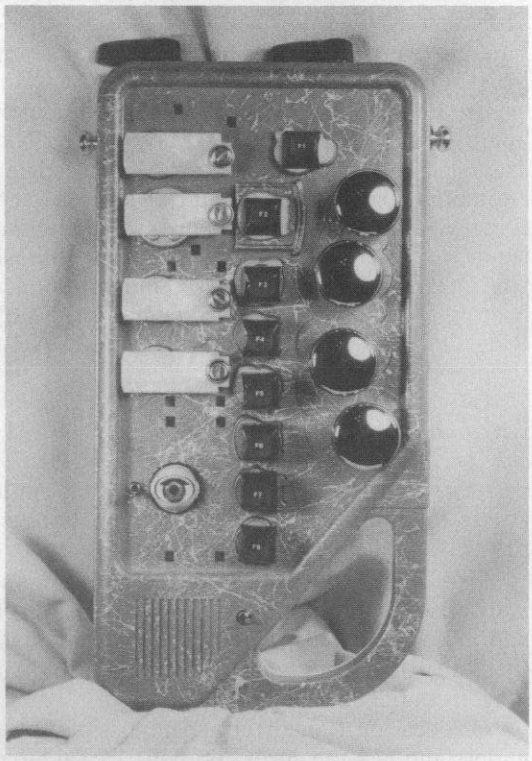
It hasn't been so long since this world was a much quieter place. Strange tones, booms, and hisses no longer elicit the attention once afforded them, now being lost in the urban soundscape or entirely consumed by the city's din. But at one time, only a few generations ago, 'unnatural' sounds were the focus of many great journals and were studied by scientists all over the globe.

Before exploding steam engines, large artillery, and supersonic aircraft, thunder was the common king of sound. In those days a booming detonation without obvious cause drew a good deal of attention. Such mysterious explosions have been reported from every continent and continue to this day. These sounds may be of either seismic or atmospheric origin and are generally known as *mistpouffers* (fog dissipaters) although they go by an assortment of local titles. Most common around large bodies of water, and lesser so emanating from below the earth or from an innocent sky, these sounds run the range from soft distant thuds to terrific explosions alarmingly close at hand.

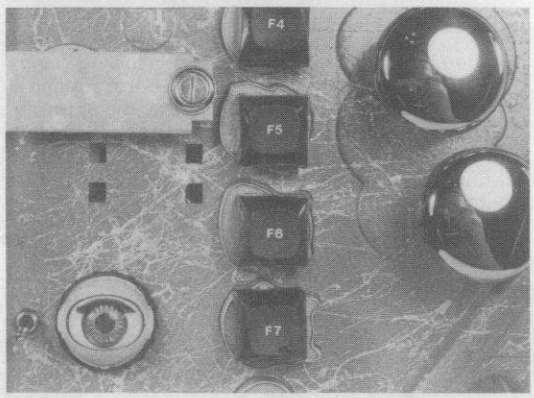
Perhaps the best known example of this phenomenon would be the 'Barisal Guns' heard along the Ganges delta. Most recollections have the rather frequent occurrences sounding like distant cannon booming in over the water, often in groups of two or three. On occasion these explosions draw closer and closer to the observer, yet so ethereal are these noises that groups of people point in all directions when asked the origin of the sound.

Closer to home are the East Coast 'mystery booms' of 1978-79. Actually, during this same time period a rash of these sounds was heard around the world, accounts flowing out of England, Canada, California, and elsewhere. Homes along the New Jersey coast rocked with the force of these explosions whose rumblings were said to create the eerie sensation of "wind shaking the house but there was no wind" (*Baltimore Sun*, Feb. 11, 1979, p. A-10).

One of the most interesting of mistpouffers are the Moodus noises, heard even now in central Connecticut and dating back to pre-Pilgrim times. In 1840 a Reverend Chapman wrote a paper on the sounds explaining that East Haddam, once called Morehemoodus (or 'the place of noises') by people he referred to as the native cannibals, was a center for worshipping the evil spirit who spoke in these strange thunders of his anger over the intrusion of the Englishman's god. Chapman went on to describe a European who, in disguise as a 'Mr. Steele,' visited the area in 1790 to search for a mysterious "fossil." One evening, according to the Reverend, Steele "brought home a white round substance resembling a stone in the light but became remarkably luminous in the dark." Chapman continues, "He said the substance was the source of the noises – that



The Morphium – full view above, and detail below



SPECIAL NOTE: Much of the information in this article was gleaned from the book **Handbook of Unusual Natural Phenomena** by William R. Corliss (Anchor Press, NY. The 400+ page text draws heavily upon scholarly scientific journals of the last several centuries and examines a very wide range of unexplained planetary phenomena. I strongly recommend this writing to all persons interested in better understanding the highly complex and largely misunderstood sphere that we call home. I'm now on my second copy, the first edition worn out by a succession of field trips into various remote regions where such texts are of great value. My advice? Purchase the hardback issue, and listen carefully.

*Circuit-Bending refers to the process of creative short-circuiting by which standard audio electronics are radically modified to produce unique experimental instruments. A further description of these techniques can be read in EMI Volume VIII #1, Sept. 1992.

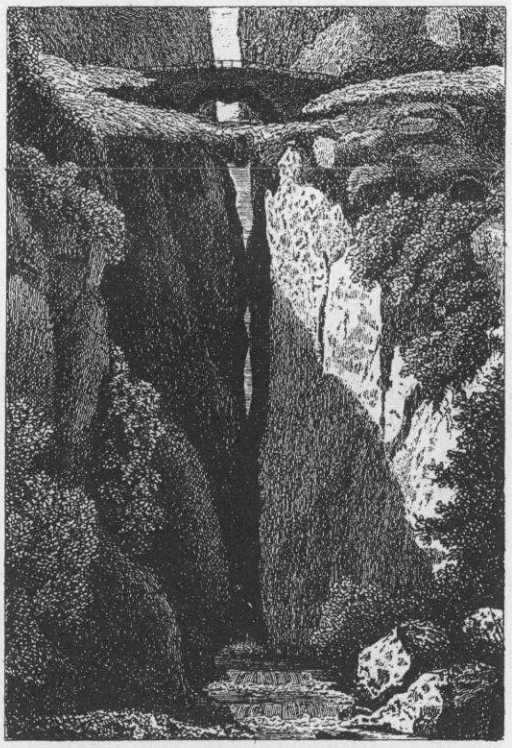
a change of temperature collects the moistness of the atmosphere, which causes the explosion."

In addition to detonating minerals, more usual mistpouffer explanations range from great pockets of volatile gasses bubbling up from the sea bed and spontaneously igniting at the surface, to meteors bursting overhead. Distant thunder, deep seismic activity, pockets of cool air falling to the sea, clear-weather lightning, even peasant-made festival bombs in the case of the Barisal Guns have all been examined and generally ruled-out by investigators attempting to unravel the mystery. Maybe folklore's fanciful interpretations such as old England's legends of "faerie farts," or the Pilgrim's notions of "the Devil raising Hell's roof to room the damned," or even the ghostly "harnts" (haunts) of the Blue Ridge Mountains are the more accurate. Ah, for simpler days.

By whatever name ... *mistpouffer*, *marina*, *brontidi*, *uminari*, *retumbo*, *the gouffre*, *sea guns*, *lake cannon*, *the Barisal Guns*, *Hanley's Guns*, *the Comrie noises*, *the Moodus noises*, plus all the countless others, the riddle of these strange detonations continues.

Less likely to be heard are the peculiar hums and whispers, the impossible 'sounds' of auroras and meteor tails, the water songs and air musics that can somehow emanate, intangible and startling, from the environment all around.

On occasion, though termed impossible by most understandings, the aurora borealis are said to dip down to the earth producing a great assortment of sounds. Not all scientists, however, have ruled out this possibility. Antoine Henri Becquerel, the intuitive thinker best known for discovering radioactivity, presented before the Academy of Sciences of Paris in 1871 a paper describing the experience of Paul Rollier while climbing Norway's Mount Ide at 4,000 feet. In this account Rollier testifies that brilliant aurora were seen dancing in the fog, quite close at hand, followed immediately by an "incomprehensible and loud roaring" which left an "almost suffocating" stench of sulfur in the air.



Ice Boom Terrain

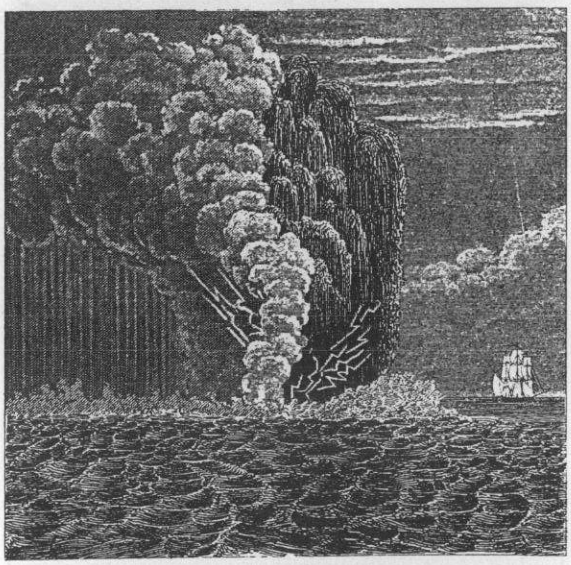
Even more incredible are the northern lights as witnessed and heard by S.G. Squires of Valparaiso, Saskatchewan. Collected by C.S. Beals, a Canadian geophysicist, and appearing in the Royal Astronomical Society of Canada, 1933, the report quotes Squires "I saw the northern lights, as we call it, waving close to the ground and among the poplar trees, with clear skies above. I went out into a field of wheat close to the house, and the light played around me and among the wheat like whirlwings [a type of insect], with a sound like silk rustling or tissue paper."

Meteor and fireball (bolide) literature are filled with examples of persons hearing hisses and odd oscillating tones simultaneous to the appearance of shooting stars. Since these fiery atmospheric disintegrations are at a considerable distance from the viewer, any immediate audible accompaniment must be termed pseudo sound. Thousands of people, including myself, have 'heard' a meteor's descent in this manner. The standard explanation is that meteoric occurrences in the atmosphere can release a distinct radiation, traveling faster than sound, that certain individuals are sensitive to and somehow interpret audibly (just as there are people who seem to hear radar along with other ultrasounds).*

A beautiful metallic string sound, chorusing and reverberant, has often been heard from the waters of Lake Yellowstone in Yellowstone National Park. The sound slowly assembles overhead, grows in volume, increases in definition, and then slips away into the distances above. Desert regions all over the world also produce a variety of odd hums, whistles, and enchanting eerie voices. Northern Chile and Peru are noted for desert sounds that swell up at night in the form of thin, high-pitched cries, sustained, vaporous, then at intervals begins a rhythmic booming, distant but distinct, sweeping over the sand in powerful, deep blows.

Stranger still are the bamboo voices along the River Linggi as reported by J.B. Scrivenor. The voices of the wind in the bamboo grove are said to speak

The engravings on this and the following pages were made by Henry Winkles. They first appeared in **Iconographic Encyclopedia of Science, Literature and Art**, published in 1851 in New York by R. Garriaue. Republished in **The Complete Encyclopedia of Illustration**, J.G. Heck (NY: Park Lane, 1979).



A water roar: Volcanic Eruption at Sea

*With "inaudible" frequencies playing a role in many of these phenomena, it's interesting to note that recent Japanese studies have clearly shown that music recorded and played back on systems capable of reproducing the natural higher harmonics (20,000 Hz to 40,000 Hz) usually lost in the recording process and supposedly unheard by humans, creates much more brain activity along with greater emotional involvement in the reproduction. I imagine this experience of music feeling more fulfilling when reproduced in 'high-spectrum' will force a new technology and eventually make obsolete most audio systems as we know them today. Infrasound will surely be addressed as well, 'bodyphones' of some type probably replacing headsets.

saying "Suda" (enough) and "Bolon" (not yet). Whimsical as this may seem, a degree of credence was afforded this phenomenon due to the testimony of various respected witnesses including the Ambassador to Achem who so clearly heard the words upon a visit in 1595 that he left somewhat shaken, probably thinking 'suda' himself.

Imagine the surprise of shouting into a deep valley and hearing the sound returned as a series of wonderful musical notes. Known as 'musical echoes', this phenomenon also covers page after page in the old scientific journals. Any sound, no matter how harsh, is returned as sweet music. An article entitled "In Lapland," by Jan Gordan and Cora J. Gordan, cites the experience of C. Macfie Campbell. "Under the high and purplish cliffs on the other side of the lake, we had a peculiar experience in acoustics; the clatter of the motor was gathered up and reflected back by these scarped rocks in a hundred echoes, but by some strange trick blended in so peculiar a fashion that the vulgar rattle and roar came to us sweetened into the chiming of cathedral bells, pastoral England's Sunday morning unbelievably imitated, now surging louder, now drifting fainter, as one would hear the bells themselves in a shifting breeze." (*Science*, 61, 1925).

My own encounters with unusual Earth voices range from charming to terrifying. Following are a handful that *EMI* readers might find interesting, and then on to the Morphium instrument.

Cold transforms the woodlands. Though I haven't heard the exploding trees of timbermen's legends, the great hardwoods of the untouched climax forests being blown apart, unevenly freezing from within and booming through the moonlit lumber camps startling all awake, I have been lucky enough to catch a few of winter's superb natural voices.

While recording the sounds of a small ice-locked river whose sizable ragged chunks had wedged together from shore to shore emitting a fascinating assortment of creaks and groans, an uncanny 'chord,' powerful yet intangible, began to grow upstream, hidden in the hills around the river's frozen bends. This chord was an Earth chord, a combination of planet-born pitches braided together by fleeting circumstance. Three distinct frequencies emerged as the event approached under a low winter sky.

It was the bass that was prominent, a rumbling that would soon be shaking the ground beneath my feet. Above that pitch were two more, the next loudest a tangle of mid-frequencies verging upon white noise, and above that a shimmering chorus of finger-cymbals filling the empty trees.

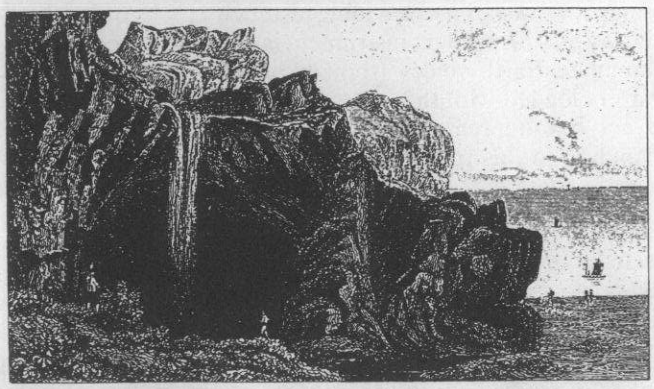
An ice dam had burst upstream. The river level was quickly rising, shearing apart at its rolling crest the crystalline blockades which shattered before the pressure, sparkling shards falling back to the ice and supplying the tingling upper pitch of the natural triad. The bass, of course, was the churning pressure of the river's rampage upon the resounding bed and shores, resonating in the frozen valleys, echoing in the cold fog of early spring. The middle pitch, entangled in itself, was the greater sound of the ice cover erupting, bursting against the river's advancing surge.

In cliff areas, spring's thaw after a frigid winter is certain to also produce what I term ice bells and ice cannon. Tramping through the gorges of melting snow I often hear the surprising crashes of ice, tons of weather-sculpted forms, blue looming masses being undercut by meltwater and snapping the last embedded root tendrils, breaking free and slamming down onto the rock far below. The booms, usually distant but still quite pronounced, seem to be accompanied by a pressure wave and slight ground tremor. Like the 'water guns' mentioned earlier, the sound is similar to a cannon firing, though in the less probable frozen and still environs of box-canyoned evergreens the deep percussions seem alarmingly out of place.

Along with immense frozen waterfalls, which form thick columns of glowing ice towering from valley's floor to cliff's edge, are the diminutive ice-forms that mosaic the boulders with hoarfrost and angle the ground with rime. Rock overhangs produce stalactites and stalagmites of freezing water, sometimes joining in the center creating miniature versions of the frozen falls. Ice bells are formed as temperatures rise and these begin to melt. Icicles dripping down onto their up-stretched partners below begin to hollow them out creating first a small concavity in the tip which eventually bores deep into the column resulting in an ice tube into which water continues to drop. Dozens of these resonant structures may form under the stony outcroppings, each ice bell of different length, width, bore, and pitch. Sitting back under one of these ledges, with a small fire and a little good food to toast amidst the melodic interplay of shimmering ice bells, has been the highlight of many a winter hike.

Along with the strange sensation of 'hearing' meteors, two other unusual personal experiences with seemingly atmospheric sounds might bear mention. Late one night, mid summer, some friends and I were sitting on a small rise within a very old and lovely cemetery. Long branches of willow trees swung low in the wandering breezes. Silent statues, solemn chapels, and tilting gravestones flowed over the grassy hillsides under an ancient rising moon. Suddenly a single, penetrating bell peal was heard by us all, accompanied by a simultaneous atmospheric pressure change so severe as to cause a moment of real concern to each of us. Nothing further happened. Probably due to the setting, we were left with more the impression of witnessing a phantom than a natural event.

Lastly, the terrifying mystery sound I previously mentioned



Mistpouffer Terrain

still haunts my memories, flooding me now with almost the same foreboding and disbelief as when I was a first-hand witness. One summer's evening while I was camped near Presque Isle in the lands of Hiawatha on the shores of Gitchee Gumee (Lake Superior) there blew in a nor'wester still spoken of today. Unlike the winds of hurricane Hugo, which were to later bear down upon my camp with definite source and direction, this gale seemed to be made of a patchwork of conflicting gusts, pitching the tent back and forth as though a huge fist gripped the crown trying to rip it from the earth. This became a supercell storm with cumulonimbus thunderheads boiling up into the stratosphere and barrel-thick shafts of lightning tearing through the air. The assault raged on through the evening and into the night, splitting the sky with electric fire, deafening every creature below.

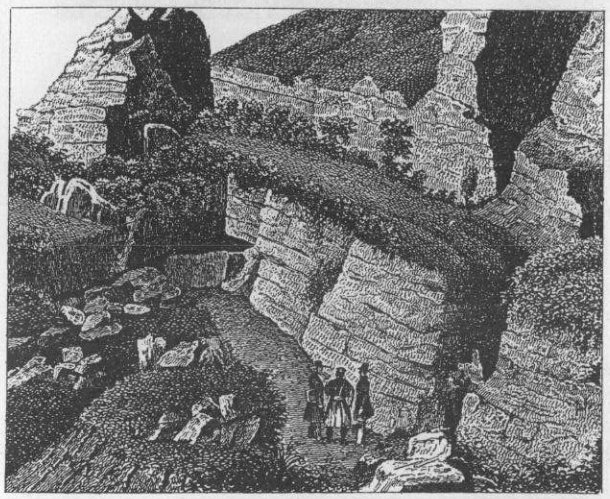
Then, above this cataclysm, impossibly louder, there began to grow an incredible roar. I asked myself over the next several hours, while the sound still grew more intense, not only how such a noise could be possible, but more frequently how such a sound could even be real since its source defied all reasonable definition.

Looking outside, nothing more than blinding flashes through pitching trees could be seen, an uncertain mass of atmosphere churning beyond. The roar was definitely at sea, somewhere out beneath, upon, or above the Great Lake. Was this a tornado or waterspout that managed to sustain itself, motionless, for so long? An anomaly of the jet stream, or an as yet unknown high-velocity surface-air occurrence? It was just SO loud. And continuous. Once tornado no longer fit, I began to imagine a deepening whirlpool, Poe's maelstrom thundering in the lake. Or perhaps it was an immense spacecraft shrouded within the swirling mists, refueling its H20 tanks from the largest freshwater reservoir on the planet.

Maybe time folded back upon itself here, as has been ear-witnessed, revealing the roaring of a primordial firmament. Or possibly even before that, this was 'nada', the echoes of the creation of the universe, "the sound of a thousand thunders," the Mother Sound itself.

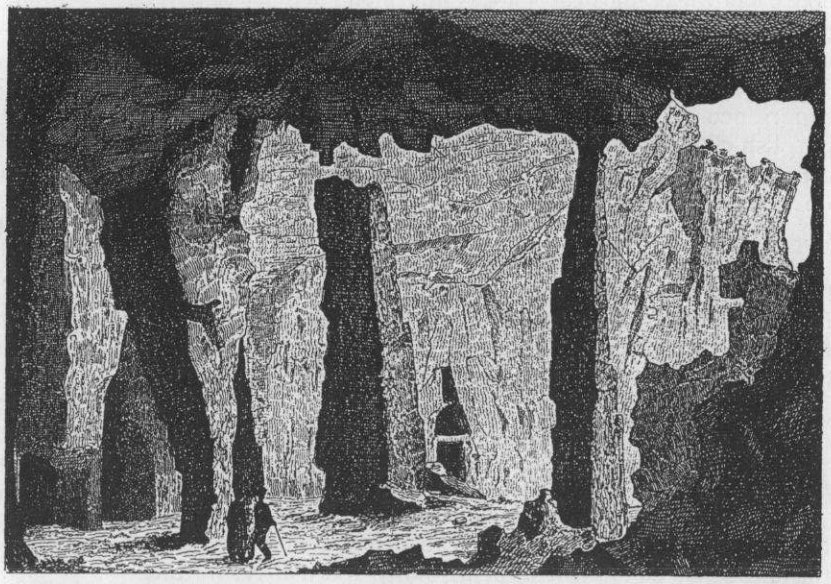
Planet Earth, like a synthesizer, looks to sources, modifiers, and mixers to produce her song. 'Natural' noises can become 'unnatural' through this process, creating sonic mysteries such as those fantastic examples described here. The idea of processing known sounds into unknown is certainly nothing new to either experimental music or instrument design, today's digital sample workstations providing just such a tool. And while my new Morphium instrument is not redesigned to simulate Earth voices (though planet-voice synthesizers loaded with the appropriate source sounds are not beyond reason), it does contribute a new vocabulary to this tradition with the peculiarities of circuit-bending now at the heart of the procedure.

Unlike other sample banks discussed in this series of articles in EMI, the Morphium relies heavily upon body-contacts for inter-flesh modulation as well as the ability to both stack and layer its digital recordings.



Musical Echo Terrain

Has anyone recognized this instrument yet? The original device, like some of the circuit-bent devices discussed earlier in previous articles, was a children's toy, depicting an old-fashioned train. Its four wheels (now under the four pearloid accordion keys visible in the photograph) could be pressed for locomotive sounds. It carried eight animals (now under the computer keys) which when pushed released their own voice samples as well. The mechanical sounds consist of steam whistle, bell, engine, and railroad track rhythm; the animals aboard are rooster, lion, dog, cat, horse,



Ice Bell terrain

goat, cow, and elephant.

The animal voices are nicely recorded and can be played atop the mechanical sounds in progress. The mechanical voices, each a recording of about four seconds, can be stacked end to end, four deep in sequence. Such are the normal functions of the device. I should note, as I have before, that today's audio toys often contain rather sophisticated electronics and are capable of producing very interesting, high-quality voices.

Circuit-bending adds to this instrument a set of four body-contacts, two potentiometers, a sky blue pilot light behind an antique winking doll eye, a speaker cut-out switch, and RCA-type line output. Strap fasteners are added to the upper housing sides so that the unit can be worn as an accordion, left hand on the four body-contacts, right hand on the keys.

Most important of the circuit-bending additions are, as you have guessed, the conductive flesh contacts. These are chrome drawer pulls wired to sensitive traces on the circuit board. Each sample bank (animal and machine) contains a pair of these metallic mushrooms which, when bridged with the fingers, decrease the pitch of the sample in play. However, volume and disintegration effects are possible by cross-touching these separate pairs, bending between the banks as well as simply within each. In this way, either mechanical or animal sounds can be themselves modified or even blended into one another giving such terms as 'cowbell' and 'dog whistle' a surprising new reality on the Morphium.

Because slowing-down digital audio streams produces such fascinating results, each sample bank now contains potentiometers (variable resistors) dedicated to this function. These dials can be preset to create special voices far outside the sample's usual personality. Doppler effects, metallic notch-filter effects, and many other single-voice modifications are possible by these means. Of course, after these banks are initialized in this manner, pitches and tones set, body-contact changes as noted before are additionally possible to further reshape and combine the voices as electricity flows through the player's fingers, the musician having become a very active section of the circuit, truly a living electronic experimental musical instrument in the most literal sense.

While I explored the Morphium for the first time, pondering its design

principles and listening to its new sounds made from old, the mysterious Earth voices we've discussed came to mind, their being born of similar process. At the moment I had been combining a rhythmic metallic train sound within cat cries, body-contact-modified just enough to turn the meows into barely recognizable but still animal-sounding calls. Massaging the chrome body-contacts in rhythm with the odd meter of the railroad tracks created an attention-grabbing vocalization a machine-animal creature whose voice was as much metal as it was flesh and blood. Even though this voice was truly bizarre – machine and modified animal – its principles were common enough for me to suspect examples waiting in the field, though I had no idea just what they might be...

So, on the rainy streets of Chinatown, as I photographed the watery reflections under the darkening purple sky, somewhere in the distance there began to form an intriguing sound. The sound was both melodic and mechanical, machine and animal combined into a flowing singular voice. Stopping now, beginning again, the song grew nearer. Around the corner then turned a little Chinese lady, singing out her sweet melody "oomblello, oomblello," modifying by dialect the word 'umbrella' and making our usual pronunciation of the word seem somewhat brutal in comparison. Was she aware that her call had fallen into the metallic rhythm that her street cart, overstuffed with umbrellas, was clattering out on the pavement blocks? If so, she seemed to notice it no more than my widening smile.

REFERENCES

Handbook of Unusual Natural Phenomena by William R. Corliss, Anchor Press, NY, 1986.

Unexplained Facts: Enigmas and Curiosities, by Rupert T. Gould, Bell Publishing Company, NY, 1980.

Sound and Music by The Rev. J.A. Zahm, C.S.C., A.C. McClurg & Company, Chicago, 1892.

Voyagers' Harbor by James L. Carter, Pilot Press, MI.

The author will accept assignments to construct any of his devices covered in EMI, circuit-bent or original, although availability of specific electronics for bending is often uncertain. Contact Q.R. Ghazala at Sound Theater, ECHO 241, 7672 Montgomery Rd., Cincinnati, Ohio 45236.

NOTICES

HANDMADE STRINGED INSTRUMENT SHOW: Northern California Association of Luthiers (NCAL), formerly BASSIC, present their second annual exhibit and sale on Sunday October 9th, 1994 at Veteran's Memorial Hall, 6401 Stockton, El Cerrito, CA. For more information call (415) 206-9531. [10-1]

WHEN THE EARTH WAS LIKE NEW: Songs & Stories of the Western Apache, a book and tape set by Chesley Goseyun Wilson, Ruth Longcor-Harnisch Wilson and Bryan Burton, is soon to be available. Included, along with a wealth of other cultural information, are recordings of and instructions for making the Apache violin. Available from Chesley & Ruth Wilson, 333 S. Alvernon Cnd 60, Tucson AZ 85711. [10-2]

VIM #4 is now available, after seven long years. VIM is the original journal devoted to Jew's Harp. You can also order the soon-to-appear VIM #5 at this time. VIM #4 and 5 are $6 each from Frederick Crane, 601 N. White St., Mt. Pleasant, IA 52641, USA. A few copies of earlier issues remain available, and Prof. Crane also has some high quality instruments from Siberian makers for sale -- write for details. [10-2]

ANYONE CAN WHISTLE is a catalogue of musical discovery, featuring great gift ideas for every age and pocketbook -- music boxes, wind chimes, drums, toys and hundreds of musical instruments from the mundane to the obscure. Call for a catalogue and request our free sampler compact disc featuring music from an array of unusual instruments, plus performer interviews. Or visit our retail store at 323 Wall St. in uptown Kingston, NY. Anyone Can Whistle, PO Box 4407, Kingston NY 12401; tel. 800-435-8863, fax 914-331-4475. [10-2]

SONIC ARTS GALLERY, home of a permanent collection of sound sculptures, venue for concerts, lectures and sound-arts demonstrations,has reopened at a new location: 2961 Beech St., San Diego CA 92102; phone (619) 231-3673. [10-2]

A mushroom goes into a bar and asks for a drink. "I'm afraid you'll have to leave," says the bar tender; "we don't serve your kind here." "Why not?" says the mushroom. "I'm a kind of fun guy!"

After a 3-year break, the student-run radio station WRUB at SUNY Buffalo is going back on the air. Programmers are seeking recordings of new and unusual music (WRUB is the only station programming new music in the Buffalo area). If you have a new music label, they'd like to hear from you. Write Charlotte Pressler at WRUB, University at Buffalo, State University of New York, 174 MFAC, Amherst, NY 14261. [10-2]

ELSEWHERES: The electroacoustic music of Hal Rammel. A CD of new recordings on the electroacoustic sound palette, designed and built by Hal Rammel. Contact Penumbra Music, PO Box 282, Grafton WI 53204 USA. [10-2]

VOICE OF EYE / VESPERS. New CD includes handmade and indigenous instruments filtered through transparent electronics. Suggested for late night trance journeys on the ship of dreams. $12 ppd from Cyclotron Industries, PO Box 66291, Houston, TX 77266. [10-1]

THEREMINS are still manufactured by and available from Robert Moog's BIG BRIAR, Inc. Rt. 3 Box 115A, Leicester, NC 28748. [10-1]

NEW stacked lamination segment drum shells, custom built to order, any wood, reasonably priced. Retail/wholesale. Call for free brochure. (413) 532-3982. [10-1/10-3]

STROH VIOLIN, PHONO FIDDLE AND RELATED INSTRUMENTS information, photos, etc., needed, for an article currently being written for EMI. If you own such an instrument, know of someone who does, or have access to documentation, and would like to share information, contact Cary Clements, 2417 Bryant St., San Francisco, CA 94110-3415, phone (415) 206-9531. [10-1]

AIR COLUMNS AND TONEHOLES: PRINCIPLES OF WIND INSTRUMENT DESIGN is a spiralbound booklet containing the four articles on practical wind instrument acoustics by Bart Hopkin that appeared in EMI in 1992 and 1993. The articles have been much revised and improved, and there are several additional features included. Published by Tai Hei Shakuhachi; available for $12.50 (no additional postage required) from Tai Hei Shakuhachi, PO Box 294C, Willits, CA 95490, or from EMI, Box 784, Nicasio, CA 94946. [9-4]

Complete or partial sets of proceedings (conference program, keynote addresses, paper presentations, transcripts of panel sessions) from last summer's Tuning of the World Conference at Banff are available from Office of the Registrar, Banff Centre for the Arts, Box 1020, Banff, Alberta, Canada, T0L 0C0, phone (403) 762-6180. Call or write for information.[9-4]

The Samchillian Tip Tip Tip Cheeepeeee is a musical instrument, a microprocessor-based MIDI controller designed by Leon Gruenbaum. A simple but powerful algorithm converts keystroke sequences from a standard computer keyboard into musical tones on an external synthesizer; the result is music never heard before with astonishing new harmonic contours. For information contact Leon Gruenbaum, 96 St Marks Place, NY NY 10009 Suite #2, phone (212) 475-5363 ext. 4. [9-4]

BIOFEEDBACK SOFTWARE/HARDWARE: WaveAccess has released WaveRider, a MS Windowsbased program with peripheral hardware that allows MIDIcompatable monitoring of biowaves. For information contact WaveAccess, PO Box 4667, Berkeley, CA 94704, (510)526-5881.[9-3]

SUBSCRIPTIONS TO EMI: $24/yr for U.S.; $27/yr for Canada & Mexico; $34/yr overseas. California residents add 7.25% sales tax for a total of $25.74. Order from EMI, Box 784, Nicasio, CA 94946, USA.

EMI BACK ISSUES: Bound volume sets Vol I through Vol V: $17 per volume. Single issues Vol VI #1 through Vol VII #6: $3.50 per issue. Single issues Vol VII #1 and later: $6.00 per issue. These prices include postage for U.S., Canada & Mexico air, and overseas surface rate. For overseas air add 20%. In California add 7.25% sales tax. Order from EMI, PO Box 784, Nicasio, CA 94946, or write for complete listing of back issues and their contents. Corresponding cassette tapes also available for later volumes; see information below.

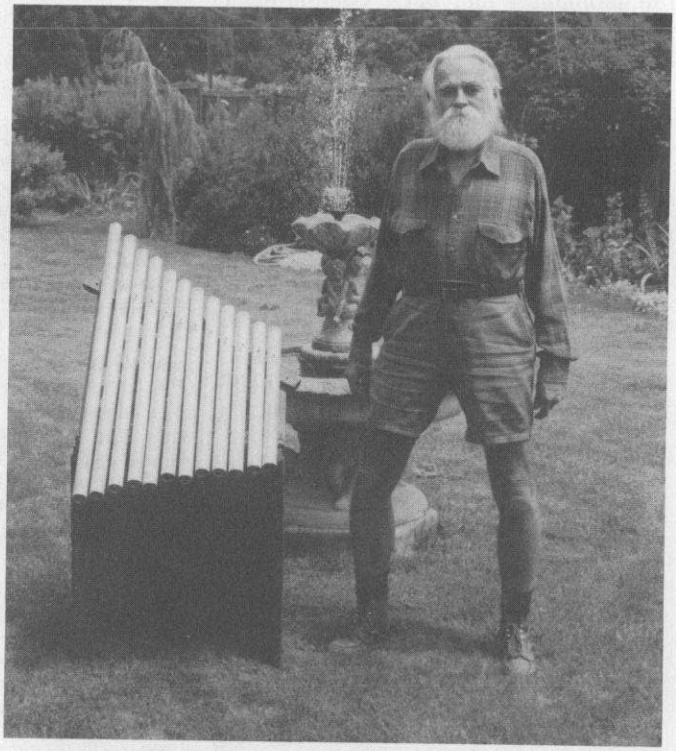
CASSETTE TAPES FROM EMI: $8 per cassette for subscribers; $10.50 for nonsubscribers. Prices include postage for U.S., Canada, Mexico air, and overseas surface rate. In California add 7.25% sales tax. For overseas air add $20%. Each tape contains music of instruments that appeared in the newsletter during the corresponding volume year, comprising a full measure of odd, provocative, funny and beautiful music. Volumes 6 - 9 remain available. Earlier volumes are now sold out. Order from EMI, Box 784, Nicasio, CA 94946.

METALLOPHONE CONSTRUCTION

By Bill Colvig

In the June 1994 issue of Experimental Musical Instruments, *we ran an article on the instruments of Bill Colvig. Appearing at the end was a note to the effect that we would soon follow with Bill's own drawings, instructions and commentary for making a metallophone tube instrument. The instrument in question is an eminently simple, practical and effective type: a set of tubular chimes made of inexpensive and readily available steel tubing, tuned by cutting to length, and mounted marimba-style for playing with mallets.*

Here's that article. But there's more: since that promise back in the June issue, the idea for the tube-instrument article has expanded. Recognizing that quite a few contemporary builders have followed Bill's lead in taking advantage of this tuned tube configuration, we've decided to follow Bill's plan with a short history of such instruments, along with additional notes on construction and materials. The followup article, under the name "Tubulonia," appears on page 26. EMI's next issue will feature notes from several more builders on some additional, rather unusual possibilities in the percussive use of metal tubing.



Bill Colvig with one of his tubular metallophones.
Photo by Sasha Bogdanowitsch

The metallophone, consisting of tuned pieces of metal played percussively, can be one of the easiest instruments for young and old to build and to play, and the sounds produced are lovely indeed.

Commercial professional metallophones include vibraphones, glockenspiels, celestes, and chimes. ("Xylo" means "wood" in Greek so the xylophone is a wood-barred instrument.) Commercial toy metallophones include toy pianos and simple pipes-on-foam-rubber metallophones. This latter is what is suggested here to build because of the availability, workability, and relative cheapness of materials and the good results obtained in sound and versatility.

Historically the metallophone has been much more used in Asiatic cultures than in European ones. (Exceptions: the Middle Ages in Europe.) The Chinese used the *fang-hsiang* [*fangxiang*], tuned iron slabs hung in a large, decorated rack, to imitate their more bulky and expensive bronze bells and jade chimes. *The fang-hsiang* is no longer in use but the world's most important metallophone development continues in full flower today in Southeast Asia, particularly in Bali and Java. This development is the Gamelan orchestra with all of its marvelous tuned gongs and bars.

The aforementioned versatility of our proposed do-it-yourself metallophone refers to the ease of switching the tuned pipes to obtain different tonal combinations or modes. The basic scale proposed is the "syntonon (intense) diatonic" which is our common diatonic scale. It was first written down by Claudius Ptolemy of Alexandria 1800 years ago. This tonal arrangement gives many mathematically simple or *just* ratios which produce much more harmonious music than our European tempered scale whose only just ratio is the octave. Most Asian music uses various 5-toned or pentatonic scales tuned justly. By removing tones from our syntanon diatonic we can make different pentatonic arrangements. A couple of advantages of using the 5 tones: it's simpler to play using fewer tones and no matter which notes are struck it sounds good anyway! Some of our familiar tunes are pentatonic and improvising on 5 tones works very well.

This is the proposed syntonon diatonic scale: (The lengths given are for 1" electrical steel tube.*)

Pitch	Frequency (Cycles/sec)	Length (millimeters)	Length (inches)	Frequency ratios
G	396	673	26 1/2	
				10/9
A	440	636	25 1/16	
				9/8
B	495	599	23 19/32	
				16/15
C	528	583	22 15/16	
				9/8
D	594	547	21 1/2	
				10/9
E	660	519	20 7/16	
				16/15
F	704	503	19 13/16	
				9/8
G	792	472	18 19/32	
				10/9
A	880	447	17 5/8	
				9/8
B	990	422	16 5/8	
				16/15
C	1056	409	16 8/32	
				9/8
D	1188	384	15 3/32	

* Due to irregularities in different runs of steel tubing, these lengths may not yield precisely the desired pitches. Fine tuning may be necessary.

The lengths are given to the nearest millimeter and the nearest 1/32". Metric's advantage in simplicity is very apparent here.

Modes to study: All are used in India.

CDE GA	Used everywhere
EGA BD	Second most common
ABC EF	Japan (folk tune "Sakura"), Java, Middle East, ancient Greece
EFG BC	Southeast Asia
CEF GB	America, Southeast Asia
EFA BC	Japan, Olympos-6th cent. B.C., Egyptian harps
GAC DE	"world scale"; the natural human pentatonic

Here is the suggested plan for our metallophone (see picture, next page):

The frame is made of wood strips about ¾" thick and 1½" wide. 2 strips are 24½" long, one is 17" and one is 9½".

The tubes, and therefore the nails between, are 1¾" apart.

The tubes rest on strips of foam plastic or rubber 1" x 1". Spacers are foam squares 1" x 1" x ½" held with nails pushed through edgewise. Rubber tubing over nails is neater; good tubing is available at medical supply stores.

The Beater; 2 needed. Disc is ¼" plywood, 2" wide. At least 4 layers adhesive tape or 3 slices cycle tube on rim.

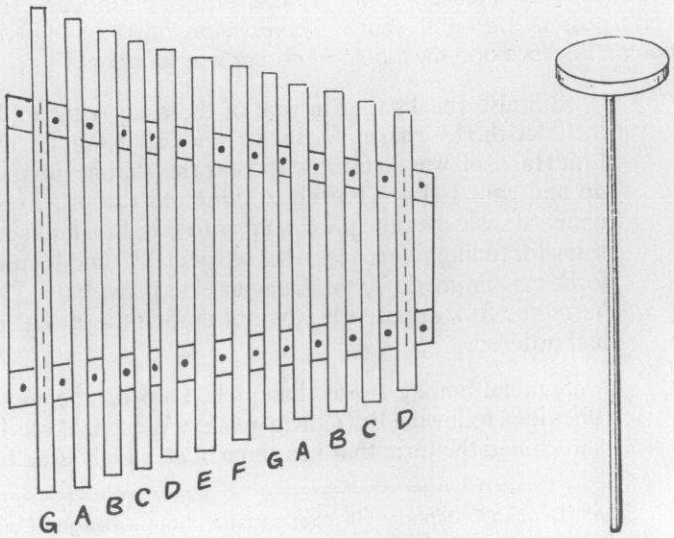
The stick; ¼ dowel, 15" long.

Metal tubing, available in hardware and electrical stores, is used for the tones. The pitch is completely dependent upon the material used and its size. Steel electrical thinwall conduit is made to rigid specifications so will come out fairly close to pitch if cut accurately to the lengths above; otherwise, special tuning apparatus is required to pitch each tone. The 1" trade size produces much better tone than the smaller standard sizes so is recommended over the lighter and cheaper ones. (Two 10-foot lengths will do it.) Aluminum gives good results also and only weighs a third as much as the steel but the sizes vary too much for length recommendations to be given. A vibrating bar or tube has two "dead" spots or nodes which give the best results for supporting locations. Here is the curving up and down (exaggerated) while vibrating:

The nodes are located at 22½% of the length from each end. Our foam cushions will work well even if the support positions are only approximate.

Notes for the madly eager theoretician: A very large part of the world's music is based on tetrachordal tone patterns. In general two identically structured tetrachords are separated by the ratio 9:8; however, there are variances and our diatonic *C* scale is one; it is not symmetrical. Starting on *E* it would be symmetrical, however, and that's the way Ptolemy gave it to us. Just tuning requires the simplest possible ratios between do, fa, and sol. We are accustomed to thinking of *A* as the relative minor of *C* but a justly tuned C-major scale will not yield a just A-minor. The E-minor is the real relative minor of the C-scale, justly speaking.

The tones produced on your metallophone will be sweet and fairly clear without using resonating elements. Clarity and strength, particularly in the lower tones, can be improved a lot with resonators, however. Quite impressive results can be obtained without fancy materials, special tools, and much time-consuming work by using common "throw-away" materials. Just setting the bells over a cardboard carton gives a little more depth; then putting jars and cans of proper size in the box under the bells will really do it. The box needs to be about 23" or 24" long and at least 8 or 10" wide. Cut down the height to about 6". Run one of the beaters along the bells then move a Campbell's soup can from bell to bell, holding it about 1/2" above the center. Suddenly the tone of one of the tubes will brighten up; that's the tube to put the can under in the box. The soup can will resonate mid-scale, about *F*. Higher notes will take shorter cans or jars and lower notes, taller ones. Small-diameter containers can be doubled to add a little strength when placed side-to side under a particular tube. On the other hand, a separate resonator is not necessarily needed for each note; a wider can can do for 2 or 3. Your "junk" resonators will not fit in a straight row under the center of the metallophone; staggered off-center they will work. A suggestion: collect a number of beer or soft-drink aluminum cans then starting with the height of the soup can, cut the aluminum cans with tough scissors to different heights, say 1/4" apart, longer and shorter than the soup can, then pick out from these your resonator set. Whatever you use, each resonator element will have to be raised up, of course, to bring the top to within about 1/2" of the tube. Blocks of wood or styrofoam can be glued on, shipping carton cardboard can be cut in pieces and laminated. Real neat: strips of cardboard starting the length of the box then shorter and shorter pieces piled up in stair steps to accommodate the resonators properly. Safety note: put Scotch tape around sharp-edged rims.



TUBULONIA

by Bart Hopkin

Tuned metal tubular mallet instruments, such as that described in the previous article, have shown their worth as an inexpensive, easy-to-make, and musically satisfying instrument type for many builders in recent years. Here is a bit of history and additional construction information.

TUBULAR HISTORY

The earliest surviving references to metal tubular chimes come to us from the 1860s, and it's quite possible that they were around earlier in one form or another. Such instruments went into commercial production after 1889 when J.C. Deagan obtained a U.S. patent for his *tubaphone* (pictured below), an instrument very much like the contemporary mallet instruments we'll be discussing here. By the 1920s it would appear that similar instruments had achieved at least some wider currency, if we can believe the Deagan Company's promotional claim at that time that "'Deagan Tubaphones' have been extensively imitated ..."

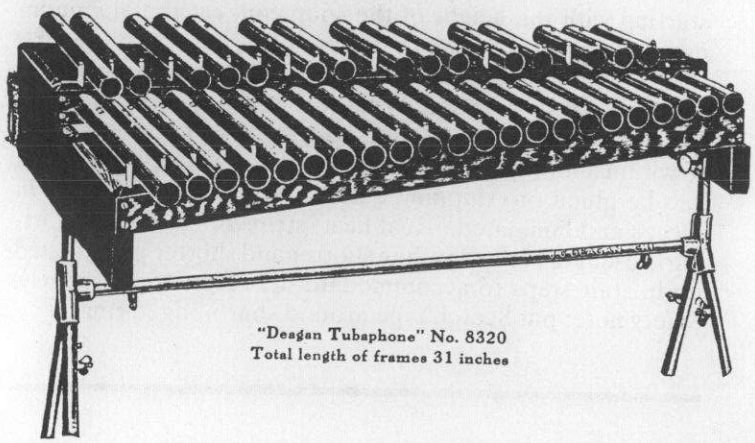
Whether tubaphone-like instruments continued to be produced in any quantity through the middle decades of the century, I don't know. We can pick up the thread again, however, sometime closer to 1970. Around that time, a number of west coast composers discovered the effectiveness of the tuned tube idea, and took to making such instruments themselves. These were individuals making individual instruments designed to serve their individual purposes, as opposed to commercial enterprises manufacturing large quantities. In most cases the material they turned to was the steel tubing known as EMT, or electrical metal tubing, manufactured as conduit for electrical wires. Several features made the electrical conduit especially promising for the purpose: It has a clear, ringing, long-sustaining tone. It is inexpensive, and widely available in hardware stores. The instrument-to-be is relatively easily and quickly made, not requiring a lot of special tools and shop-work skills. Finally, it is fairly easily tunable by cutting or grinding to pitch, and retains its tunings with near-perfect stability virtually indefinitely. For many of these builders, the tunability was especially valuable. These were the early days in what has now become a tidal wave of intonational exploration. Following Harry Partch, an increasing number of contemporary composers were turning away from the standard 12-tone equal temperament scale and looking to other tunings. As Partch had found, if you're going to compose in non-standard tunings, you need instruments that can play in those tunings. Relatively few composers had access to the tunable synthesizers and computer systems that have now become more widely available. The steel conduit tubes provided a ready way to create an instrument to fill the need. So it was that most of the composers and builders who took up the instrument were microtonalists in search of tunability.

The first among the contemporary West Coast musicians to work with tuned metal tubing, it appears from the accounts that I have gathered, was Bill Colvig. The impetus came, he says, "from being a musical electrician working with conduit, and my taking up with Lou Harrison, one of the older Just Intonation nuts." He continues –

I met Lou in 1967 and was soon playing Chinese instruments. One piece required tuned water bowls. They were quite a problem, what with the guesswork getting just the right amount of water for the tone desired and the peril of knocking them over when playing. Also, after the water sat awhile a film of bubbles from dissolved gases would form, dulling the tone and eventually nulling it. We decided to substitute tuned conduit pieces and I soon hit upon 1" trade size EMT to be proper for our purpose. We first tuned by ear a pentatonic two octaves (11 tubes) with supposedly just ratios. I'd worked with an oscilloscope in military Aircraft Warning in Alaska in WW II and it occurred to me that that would be just the ticket to achieve accurate ratios, so next I went to Zack's on Market street and, for $60 I think it was, bought a Heathkit 'scope. I told Lou "Here's the oscilloscope I told you about" and dumped out onto the bed a whole pile of tubes, condensers, resistors, transformers, control knobs, potentiometers, cathode-ray tube, and, thanks be, the instruction book! We studied and soldered and studied and soldered and Lo! a beautiful sine wave appeared on the 'scope tube. I started to tune our metallophone using the oscilloscope and the ratios Lou had specified, and he called from the other end of the house "That can't possibly be right!" but on completion he lit up like you couldn't believe and my tubulong career was launched.

Bill also recalls that in one of their experiments he included the 13th harmonic in the Indonesian Pelog scale. Lou Harrison was so excited to hear this that he jumped up and called Harry Partch to bong out the previously unheard scale over the phone. Prior to this, Lou had been using for tuning references a set of specially-tuned tuning forks custom-made by the Deagan Company, but a 13th harmonic fork apparently was not among those that he had ordered.

Seminal among those that picked up on the metal tubes idea following Bill Colvig was Erv Wilson. It was he who coined the term that has since been widely used for



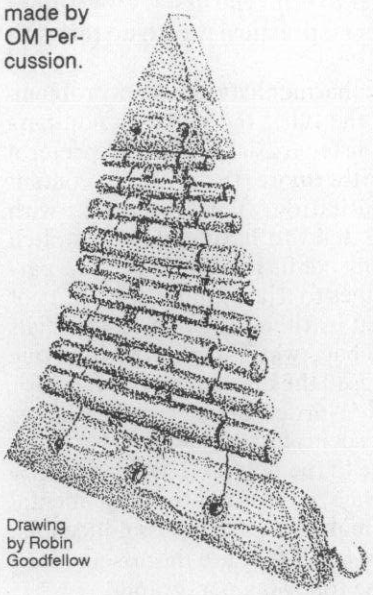
"Deagan Tubaphone" No. 8320
Total length of frames 31 inches

Left: Deagan Tubaphone; illustration taken from a Deagan Company catalog of the 1920s. Several of these catalogs were reprinted in their entirety in **Percussive Notes Research Edition** Volume 24, Numbers 3/6, March/Sept 1986.

the conduit instruments, *tubulong.** Erv has worked extensively with tonal geometries – that is, designing spatial arrangements for the pitches in different tuning systems, intended both to reflect in space the pitch relationships between the tones, and to facilitate ease of playing. In tubulongs he had the opportunity to build instruments to realize tonal geometries that he had designed. Many of his layouts take the form of two-dimensional arrays, with the pitches laid out in three rows. Erv's first tubulongs, made around 1975, were for 31 tones per octave (see diagram below); later instruments were made for 22 tones, 41 tones, and even 72 tones per octave.

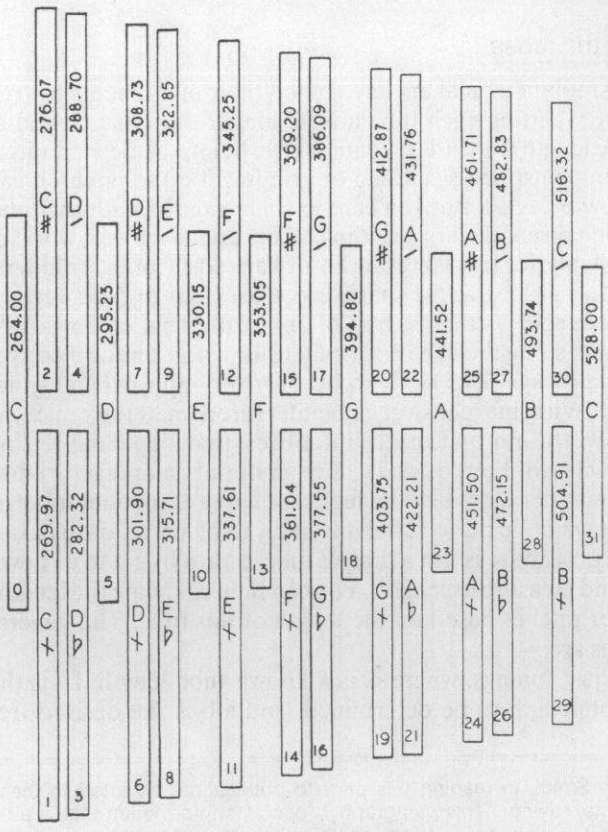
A number of other builders subsequently built tubulongs for various tonalities following layouts created by Erv Wilson. Among them, Craig Hundley's 1980 tubulong for 53-tones-per-octave used a vertical suspension arrangement, and featured aluminum tubes rather than steel. Stephen Smith made two tubulongs (which he referred to as conduit marimbas) in layouts based in Wilson designs. These were featured in *EMI*'s Volume II #1, June 1986. His 31-tone instrument was a direct copy of one of Erv Wilson's instruments, using a flat arrangement in three ranks. The 53-toner used horizontal tubes in a big vertical array. More tubular ideas from Stephen Smith will be found in a follow-up article to this one, slotted to appear in the coming issue of *Experimental Musical Instruments*.

Several more names to mention: Ivor Darreg built several tubulongs during the 1980s, mostly to explore unfamiliar equal temperaments. Buzz Kimball has done likewise, and we have a 31-tone equal set tuned by Buzz here at EMI's corporate headquarters in Nicasio. Since they're reasonably weatherproof, I keep them set up outdoors, for playing under the stars. Skip La Plante, of the group Music for Homemade Instruments, has made tubulongs for the group's performances, once again primarily for higher-order equal temperaments. Dean Drummond, working with the group Newband in New York City, uses a metal tube instrument he calls Zoomoozophone. Leaving behind the rough-and-ready quality of many earlier instruments, the Zoomoozophone is finely wrought and justly tuned, using a high grade of aluminum tubing manufactured to be as free as possible of dimensional irregularities, played in such a way as to yield a tone with a minimum of inharmonic partials. Daniel Schmidt, known for the fine acoustic design of his American gamelan instruments, has at various times worked with tubular instruments, including some work with Bill Colvig and others in the early days of the American gamelan movement. His work, too, in some of its unique aspects, will be discussed in the article to appear in the next issue of *EMI*. The people at Woodstock Chimes (makers of exquisite tubular aluminum wind chimes under the direction of Gary Kvistad) have for the last few years been selling an attractive little 8-tube instrument called Chimalong. It's designed to be affordable and kid-playable. The mounting system, with the tubes snugly inserted through holes in what appear to be two semi-rigid foam support strips, is clever in its simplicity and effectiveness. Several other manufacturers as well have made simple struck tube instruments for children's and classroom use.



Suspended tubular chime set made by OM Percussion.

Drawing by Robin Goodfellow



Pitches to base C264 are rounded-off from tables by John Chalmers

Layout for 31-Tone Tubulong by Erv Wilson

THOUGHTS ON CONSTRUCTION & ACOUSTICS

From reading the preceding material you may have gleaned many of the basics for making one of these instruments, and the plan from Bill Colvig that precedes this article will take you through the process step by step for one particular design. What follows here now are some general considerations in design and construction, which you may find helpful if you are taking an exploratory approach to design rather than following an existing pattern.

Because it will help clarify some things that follow, we need to have a preliminary discussion of one particular consideration. Several of the design questions to be addressed hinge upon the matter of overtone content in the tubes' sound, and its relation to tone quality and tuning. The naturally occurring overtones in the cylindrical tube sound are non-harmonic, just as they are

* Erv Wilson's original term was **tubulon** (no **g** at the end), conceived by phonetic analogy to **gamelan.** Currently, he calls the instrument a **tubulong**, while others, seeing the many tubes on a single instrument, have pluralized it to **tubulongs**. The term has since spun off the widely-used variant **tubalong** or **tubalongs**, which brings to mind an image of the happy player, Tubalong Cassidy, just tubing along on some cheery melody ("Merrily we tube along, tube along, tube along ..."). Erv has more recently commented that if he could do it over again the name would be "Tubularis."

with other uniform bar shapes. With wooden bars, there are ways to re-shape the bar in order to bring the first few overtones in line harmonically, but there's no practical way to do this with metal tubes.

You may decide that this inharmonicity is a non-problem, and that you like the sound of the tubes the way it is, non-harmonic partials and all. Many listeners, however, will prefer a more refined tone quality. Furthermore, the overtone content affects the overall tuning situation: Tone qualities with prominent inharmonic partials tend to have ambiguous pitch implications, and are potentially confusing to the ear. In particular, if you have tuned the tubes to a just tuning, the purity of the tuning will be compromised by the wildly non-just partials ringing through all the time. That's why some of the tubulong makers mentioned above have used the instrument primarily for non-just tunings such as higher-order equal temperaments, where the purity in the tunings seems less sacrosanct. *

The most practical response to the potential problem of too much inharmonicity is to find ways to bring out the fundamental prominently in the tone, and to make the partials less noticeable. There are several ways to do this, and they are discussed, along with other considerations, in the following paragraphs.

Choosing tubing material

As indicated already, the galvanized steel conduit known as EMT, or electrical metal tubing, has served as the standard tubing material for use in tubulongs and related instruments. Its advantages are availability and affordability. Its main disadvantage is a tendency to a rather clangy sort of tone quality, which results from the prominence of the partials. In addition, the inexpensive steel tubing has a seam along the inside. The seam, by destroying the 360 degree symmetry of the tube, makes it a tiny bit more rigid for vibration in certain directions. As a result the tube produces slightly different pitches depending on the direction from which it is struck. With certain angles of strike, the tube sounds both pitches simultaneously. The ear hears this as a single compromise pitch, but with the wavering volume effect known as beating.

The tubing comes from different manufacturers, and the seam is more prominent in some tubings than others. I have found that the sort that has a shiny, rough, surface, sometimes called "snakeskin," is preferable in that it usually has a less prominent seam than the dull, smooth-surfaced variety. Even with less seam-ridden tubings, makers should try to keep the same side of the tube oriented upwards as you tune each tube and later place it on the instrument. This will help assure that the player consistently strikes it from the same direction, minimizing any pitch inconsistency. If you like the beating effect (you may find it attractive, like a vibrato or tremolo), you can orient the tube for a striking position that brings it out. If you don't like it, you can orient it so as to minimize the beating.

Other tubing materials may be richer or warmer in sound, yielding less of the clangy tone mentioned above. Historically people have often looked in situations like this to brasses and bronzes. Bell metal, which was used in the Deagan tubaphones as well as countless other bell-like instruments, is a bronze alloy of four or five parts copper to one of tin. However, many contemporary makers (though not all) have favored high grade aluminum as having the clearest tone with the least clanginess. Whatever the material, more expensive tubings manufactured to higher standards are more likely to be free of the troublesome seam as well as other irregularities.

But listen: even with plain old EMT you can get a satisfying sound, particularly if you follow some of the procedures discussed in these pages for bringing out the best in the tubes.

Tubing dimensions and proportions

One of the conveniences of EMT is that it is readily available in diameters ranging from 1/2" to something over 2" (tube sizes are represented by inside diameters, and actual size often differs from nominal size). Most tubulong-like instruments have used the 3/4" or the 1" size. Considerations of bulk, weight and expense, one suspects, have played a major role in choosing these sizes. Larger diameters generally sound louder and richer in tone, and this becomes increasingly important lower in the range. As the tubes for those lower notes become longer relative to diameter (as the L/D ratio increases) the overtones dominate the tone increasingly. At a certain point they come to overwhelm the fundamental, and the ear ceases to hear the fundamental as the defining pitch. The solution here is to use larger diameters for the lower notes. Yet most tubulong makers have found it possible to cover their desired range – typically two octaves – with a single tubing diameter. The lowest notes may be a little thin sounding in such cases, but not unacceptably so. To give you a rough sense of how the tube-diameter/musical-range question typically plays out: with 3/4" EMT conduit you can get decent tone quality over a range from about G below middle C to something over two octaves above middle C. Bear in mind that larger diameters of tubing require greater lengths to yield the same pitches – for example, a tube producing middle C on 3/4" EMT is about an inch longer than a 1/2" tube producing the same pitch. Choice of diameter also affects the width of the overall layout, which has implications for the player's "reach."

Tuning the tubes

Most tubulong makers have tuned their instruments by trial and error, cutting each tube a little longer than its guessed-at ultimate length to produce a tone a little below the desired pitch, and then painstakingly cutting or grinding it up to pitch. It can be a slow process. But you can do some simple math that may save you a great deal of grinding. This approach will work, at least roughly, for free vibrating bars of any sort (tubes, cylinders, flat bars...) as long as the shape is not irregular in cross section over the length – that is, free of any scalloping, narrowing or thickening along the bar. With materials of non-uniform consistency like woods it is likely to be only very approximately accurate. With inexpensively manufactured materials such as EMT it will be more accurate, but still less than dependable (fine tuning will still be required). For materials manufactured to very close tolerances like the highest quality aluminum tubings, it still may not be perfect, but it is likely to be pretty darn close.

The procedure is: cut a sample tube, tune it by ear to a known pitch, and measure its length. You can then calculate the lengths for other pitches based on the length of this tube. The general formulas are –

For just tunings, where L is a known tube length, L' is the new tube length to be determined, and a/b is the desired fre-

*Stephen Smith, in reading this prior to publication, objected to these statements, saying: "This paragraph ... contains information that is a bit too subjective while trying to sound objective. My **subjective** experience is this; I have made tubulongs in both just and high order equal temperaments. My ear has focused in on the fundamental, which I have been able to bring out strongly enough to have no problem with 'ambiguous pitch implications' (a subjective term which is not defined clearly)." He goes on in his comments to discuss more subtle aspects of the timbre/tuning/pitch perception question, beyond the scope of the current article.

quency ratio between the two tubes,

$$L' = \sqrt{b/a} * L$$

For tuning in any n-tone equal temperament, where L is a known tube length and L' is the new length to be determined for the next scale degree up,

$$L' = \sqrt[2n]{.5}\, L$$

From these you can derive some useful constants: To produce a tube one octave higher than an existing tube of known length, the new tube should be 0.7071 as long. For an octave lower, make it 1.4144 as long. For a semitone higher in the standard 12-tone equal temperament, make it 0.9715 as long; for a semitone lower, 1.0293.

These formulas and values follow from the physical rule governing uniform bars, that frequency and length are related as the inverse squared.

Resonators, radiation, and reflection

Tubes have an advantage over solid cylinders and bars in that they have lots of surface area, which makes them efficient sound radiators. For many purposes tubes alone produce reasonable volume without need for additional enhancement. That said, it can still be valuable to fit a tubular instrument with external sound resonators, radiators or reflectors. These will serve to increase the general volume, improve the tone, and particularly enrich the lower frequency output,

Simply making the support system for the tubes in such a way that the tubes are a suitable distance above a flat, reflective surface will noticeably enrich the tone, especially for lower notes. That surface may be a floor or table top, or a stand for the instrument that incorporates a table-like surface under the tubes. The appropriate distance from tube to reflector varies with frequency.

If the support frame forms a trough-like enclosure under the tubes, air resonance within the trough may also contribute a general lower frequency boost, in a manner roughly similar to the sound chamber of a string instrument.

Marimba-like instruments with flat bars often have air resonators suspended below the bars to enhance the fundamental and generally increase volume. The round surface of a tube doesn't drive the air in the resonator as efficiently as the flat undersurface of a marimba bar; none-the-less, tuned air resonators can definitely improve struck-tube sound, particularly for the lower ranges. As with marimbas, the resonators usually take the form of stopped tubes hung directly below each of the metal tubes that the player strikes – or, alternatively, below only those tubes in the lower part of the range. The air resonance of the resonator tubes is tuned, by adjusting the position of the stopper within, to match the fundamental pitch of the metal tube above. The process is essentially the same as that for marimba bars, and it has been discussed in previous articles in this journal, including Stephen Smith's article appearing in *EMI* Volume II #1, June 1986. One special consideration for resonators on metal tube instruments: The metal tubes are usually relatively narrow. A row of resonator tubes below would have to be comparably narrow, if they are to fit as on a marimba. But such narrow resonators may not prove very effective. To accommodate broader resonator tubes under narrow struck tubes, the resonator tubes need not be precisely under the center of each metal tube, but can be staggered in two rows, or placed alternately under the centers and ends of the metal tubes.

Another clever way you can enhance the tube tone is to use the tube's own internal air column to provide the air resonance. To do this you must find a way to tune the air column pitch to match the tube's fundamental chiming pitch. For reasonable tube lengths and diameters, the air resonance pitch sounds well below the chime pitch initially. I have found that I can raise the air resonance pitch to match the chime pitch by drilling toneholes along the side of the tube. When I have sized the toneholes right and the resonance match is achieved, the increase in volume and richness is just as you would wish. But, in truth, there are problems with this method which make the tuning process difficult and time consuming, and which to some extent compromise the acoustic result. *However*, just a few days before press time for this article, I heard about the work of Charles Sawyer up in the Sierra foothills. He has found, and even patented, a much simpler and more effective way to achieve the same result. I won't go into it here – you can count this among the things to look forward to in the follow-up article to this one that will be appearing in *EMI*'s next issue.

Mounting the tubes

There are countless ways to mount the tubes. The primary acoustic consideration is this: the tubes should be mounted in a manner that leaves them free to vibrate, particularly in the fundamental mode. The tubes must not be held rigidly: the less restrictive the mounting, the clearer the sound. Whatever supports them should contact them at or near the points of minimum vibration (nodal points) for the fundamental mode. In the characteristic vibrating pattern for that mode, there are two of these nodal points, located at about 22% of the bar's length from each end. Thus, if the tubes are to be held by strings passing through holes, the holes should be drilled at these 22% points on the tube. If they are to rest on foam pads, the foam pads should be spaced

TUBULAR BELLS

The orchestral instrument usually called *tubular bells* has existed in more or less standardized form through most of the twentieth century. It differs from the other metal tube chimes discussed in this article in a several of respects: First, the tubes are suspended upright and struck at the upper end. Second, the tubes are stopped at the upper end. I'm not sure of the reason for the stopped end — does it have something to do with air resonances within the tube? Or is it to reinforce the rim of the tube, distributing the mallet's impulse uniformly across the top rather than letting it flex into oval configurations? Third — and this is the most significant difference — the orchestral bell tubes are relatively long and narrow. As a result, the fundamental is not prominent, and the ear does not hear it as the defining pitch. The tone that the ear hears as the defining pitch is based in partials above over the fundamental. The practice of striking the tubes at the ends contributes to the effect by exciting all the overtones more or less equally. However, there are conflicting accounts of the etiology of the perceived pitch. Since I have not had the opportunity to look into the matter myself, I won't try to deal with the question here. The non-harmonic tuning of the partials contributes to the bell-like effect, allowing the instrument to be used as a more portable and affordable substitute for large carillon bells.

so that the tube rests on them at or near those points. The nodal points for the fundamental mode do not coincide with the nodes for other modes of vibration; thus, mounting in this way will have the desirable effect of damping the upper partials while favoring the fundamental.

Additional factors to consider in designing a mounting system are ease of playing, tonal geometry (how the layout of the pitches reflects meaningful tonal relationships), ease and inexpense of construction, appearance, and portability. One style of framework that I personally like is no framework at all. Simply glue small foam pads to the underside of each tube at the nodal points, giving each tube its own little padded stand. Keep the tubes in a box under the bed, and when you're ready to play them, pull them out and lay them out on the floor or a table in whatever sort of layout you like. You will get a better tone by using two layers of foam: a softer, lighter foam stuck directly to the tube, and a denser foam below that to provide a broader and more stable base. Weather stripping, with its adhesive backing, can be useful in this application.

I'll say no more about mounting systems, since this is an area where individual preferences, provided with a ballast of common sense, can prevail.

Playing technique

I'm sure I needn't say much about playing technique either, but I will mention two things that will contribute to the taming of the inharmonic partials.

1) The tubes will produce the clearest tone when struck at or near the center, exciting the fundamental most strongly. Striking at the ends is almost as good.

2) Choice of mallets makes all the difference in the world. Superball mallets will probably be too soft, yielding poor definition and volume. Wooden knobs will probably be too hard, yielding too much clang. You need something in between. As mentioned in Bill Colvig's article preceding this one, mallet heads made with wooden disks work well because it's easy to pad them by wrapping the periphery with layers of inner tube or adhesive tape. You can make them just as hard or soft as you wish by varying the number of layers of overwrap. The wooden disks are easily cut with a hole saw. You can also try a mallet head made of a hard knob, such as a wooden drawer pull (available at hardware stores), padded with a layer or two of moleskin (a foot-care product, available at pharmacies). Or give the hard knob several coats Plasti-dip, a liquid rubber sold at hardware stores to provide an insulating coating for tool handles. Its non-slip qualities aid in preventing the mallet from slipping sideways off the round surface of the tube and inadvertently striking the adjacent note.

Special thanks go to several people who read this article prior to publication and offered their comments and corrections. These people include Bill Colvig, Stephen Smith, Buzz Kimball, Erv Wilson and Skip La Plante.

Stephen Smith was particularly generous in supplying additional information, and in the issue of EMI following this one we will present more of his notes on the tubular mallet instruments discussed here, including ideas on resonators, mountings, and more experimental designs. As part of the same feature, we will present further tubular ideas from Daniel Schmidt, Charles Sawyer and Bart Hopkin. Stay tuned.

BOOK REVIEWS

by Bart Hopkin

DAVID DOTY: **THE JUST INTONATION PRIMER**

75-page book published in 1993 by The Just Intonation Network, 535 Stevenson St., San Francisco, CA 94103. 75 pages; price $6 for Just Intonation Network members, $8 for non-members, free with new membership in the network.

In recent years an increasing number of composers and theorists have become interested in just tunings, and a growing body of new work in the field has developed. But until recently, resources available to beginning students in the area have been pretty scarce. Now we have *The Just Intonation Primer: An introduction to the theory and practice of Just Intonation.* Author David Doty is an appropriate person to create such a work. He is one of the founders of the Just Intonation Network and editor of the network's journal 1/1; he has the requisite subject matter expertise in generous measure, and he has been in a position to know what students of the subject want and need. The book that results is a concise, practical, informative, and very affordable text.

It is also, one should mention, a piece of advocacy. David Doty believes firmly in just intonation, and in *The Just Intonation Primer* he promotes as well as elucidates.

Doty's Primer opens with an introductory section serving to define just intonation, and providing some history and context. The following chapter, titled "Acoustic and Psychoacoustic Background," introduces additional important terms and lays out some basic acoustics. More importantly, this second chapter establishes the practice of just intonation not simply as an arithmetic for the construction and analysis of musical scale systems, but as an approach grounded in the very nature of musical sound. Chapter three is "Basic Definitions, Conventions, and Procedures" It is devoted to underlying mechanics of just intonation work as developed by its modern practitioners, covering such topics as addition, subtraction and complementation of just intervals, calculation of frequencies and cents values, the significance of prime numbers in just intonation, interval names and notation systems, and more. The next two sections of the *Primer* address the essential business of construction and analysis of just tunings, describing some specific just scales and providing tools for the development and analysis of others. The last section is "Practical Just Intonation with Real Instruments," an overview of options for the performance of just music. It aims more to refer readers to further sources and areas of study than to provide complete information in itself.

The Just Intonation Primer, being intended as an introductory text, does not require previous knowledge of tuning theory or acoustics on the reader's part. It does call for some knowledge of "common practice" music theory. While it doesn't demand mathematical background beyond basic arithmetic, it will call for real mental effort for anyone new to the game who is not a natural-born number cruncher. Doty has a bit of an inclination to complex language. The information is all there, and in coherent and comprehensible form, but digesting it all will not always be a fast and easy process. In the third chapter in particular ("Basic Definitions, Conventions and Procedures"), some procedures are introduced in what, for beginners, may seem like a vacuum – abstract operations whose usefulness is not obvious at this stage – making the information difficult to retain. For many people the way to learn this stuff, I suspect, will be to give the *Primer* a first read-through, coming away with less-than-complete understanding, then try some hands-on application of the knowledge gained (through composition or analysis), then return again to the primer for a second, somewhat wiser read-through ... and perhaps even to repeat the cycle another time or two. I can also easily imagine an instructor augmenting the *Primer* with exercises and additional materials to provide the needed hands-on experience in more simultaneous fashion.

Author David Doty is currently planning a second volume of approximately the same length to complement *The Just Intonation Primer*, tentatively titled *Further Studies in Just Intonation.* For the meantime, we have an excellent resource in this first volume, and one which fills a long-standing need.

RALPH DAVID HILL: **SOUNDS OF JUST INTONATION: INTRODUCTION TO NONTRADITIONAL HARMONY,**

Typescript, music scores and two cassettes tapes, produced in 1984 by Ralph David Hill; available from the Just Intonation Network, 535 Stevenson St., San Francisco, CA 94103.

There is one disadvantage to *The Just Intonation Primer* just discussed, as there is with any written text on tuning theory. It is that text alone doesn't convey the sounds; and sounds, after all, are the heart of the matter. With that in mind, we turn to Ralph David Hill's *Sounds of Just Intonation. Sounds of Just Intonation* is essentially a just intonation lecture-demonstration on tape. The package includes 35 pages of written text along with some other written materials, plus two cassette tapes. The tapes contain the author's reading of the text, interspersed with musical examples. Written scores for the examples are provided as well. Following the reading of the text, side two of the second cassette presents a "Concert of New and Old Music," containing just intonation pieces in diverse styles.

Hill follows the "Tell 'em whatcher gonna tell 'em, tell 'em, and tell 'em whatcha told 'em" school of expository writing. This makes for a slightly stiff prose style, and may even create some tedium, but it also contributes to clarity of exposition and unambiguity of purpose, which no doubt was the author's intent. Hill's sequencing of the work – the progression of ideas from simple to more complex intervals – works well; rarely does the listener have difficulty either following the text or hearing the salient qualities of the musical examples. A great strength of the work

*The opening words in David Doty's **Just Intonation Primer** are "What is Just Intonation?" A brief answer for those new to the subject who might be reading this review: just intonation is an approach to understanding musical tunings (intervals, scales, pitch relationships) in terms of the ratios between the vibrational frequencies of the pitches involved. Just tunings are tunings in which the pitch relationships can be expressed as reasonably simple frequency ratios. Proponents of just intonation argue that a preference for simple ratio relationships agrees with the way the ears and brain perceive musical intervals, and also sits well with certain mechanical aspects of the acoustics of musical sound. Most western music today, in contrast, makes use of a particular scale called 12-tone equal temperament. 12-equal is designed to approximate certain important just intervals, but it is not actually just, as its underlying mathematical logic is not ratio-based.

is in Hill's elucidation of how subtle shadings within musical intervals become meaningful in musical context. He achieves this in part by a very patient sort of presentation: he invites the listener to study the aural effect of the intervals in different contexts by presenting them lingeringly and with a lot of repetition.

No previous knowledge of tuning theory is prerequisite for *Sounds of Just Intonation,* although some familiarity with common musical practice will be valuable. People who have read or thought about just intonation without having the chance to study it by ear will especially enjoy this opportunity to scrutinize those intervals. The musical examples cover the important 5- and 7-limit intervals (for those unfamiliar with this terminology: the lower the prime number limit, the more basic and familiar the resulting intervals and scale systems). Moving on to 11- and 13-limit, where the possibilities rapidly multiply, Hill does not attempt to be exhaustive, but presents a sampling of harmonies that he has found to be particularly useful or appealing. Hill's approach to some aspects of just intonation and its terminology differs in minor respects from that followed by some other theorists, including that offered more recently by David Doty in the *Just Intonation Primer.* This is to be expected in a discipline as much in ferment as contemporary tuning theory, and will not be a significant deterrent to understanding.

Since *Sounds of Just Intonation* was produced a decade ago, there has been a lot of progress in the tools used to to realize justly tuned music electronically. The computer-controlled synthesizer that Hill put together for the musical examples heard here leaves a bit to be desired by today's standards, with an artificial-sounding tone quality that at times seems somehow both saccharine and grating. It serves the purpose none-theless, producing clear and accurate pitches, and even (demonstrating the power of just intonation) allowing some of the concert pieces at the end to sound to surprisingly good effect. His chosen timbres, as is appropriate for just tunings, are harmonic (i.e., the overtones within the overall tone are true harmonics of the fundamental pitch). Hill does not address the matter of how timbres interact with tunings – space limitations probably would not have allowed it. It's fun to note, though, that with some of his timbres, on my playback equipment at least, some of the intervals produced wildly conspicuous difference tones. With just intervals these difference tones bore coherent musical relationships to the pitches above. With the non-just intervals occasionally presented as counter-examples, they rumbled forth at completely unrelated pitches: another unintended demonstration of one of the important qualities of just intonation.

A final footnote: Ralph David Hill, in producing this package, was meeting a need for alternative tunings to actually be heard. Another who strove to meet the same need was the recently deceased Ivor Darreg. He produced (or, in his phrase, "ground out") a number of tapes intended to demonstrate the sounds not only of just tunings, but of a whole array of non-standard equal temperaments. Ivor's vast tape collection is currently being archived by Brian McLaren. For information on special-ordering items from this collection, contact him at 2462 S.E. Micah Place, Corvalis, OR 97333-1966. In addition, the newly-released Ivor Darreg CD contains pieces in a series of higher-order equal temperaments, with tonalities of each clearly identified in the liner notes. See the display ad elsewhere in this issue for details.

RECORDINGS REVIEWS

By Sasha Bogdanowitsch, Mitchell Clark, Tom Nunn & René van Peer

This issue's review section begins with a special focus on recordings of Indonesian and Indonesian-inspired music.

PANKUR-PAMIJEN

SLONDING

FANTASTIC GAMELAN

MUSIC FOR SALE

All on cassette from the American Gamelan Institute, Box A36, Hanover, NH 03755

ASMAT DREAM: NEW MUSIC INDONESIA, VOL. 1 (SUNDA)

On CD from Lyrichord, also available from American Gamelan Institute, address above)

INTERACTION: NEW MUSIC FOR GAMELAN

(Complimentary CD to **Leonardo Music Journal** Volume 2; also available from the American Gamelan Institute(address above)

SONGS BEFORE DAWN / MUSIC OF NIAS & NORTH SUMATRA (MUSIC OF INDONESIA 1 & 4)

On CD from Smithsonian/Folkways, 955 L'Enfant Plaza Suite 2600, Smithsonian Institution, Washington, DC 20560

The *gamelan* is an intriguing vehicle for music. It is part of an ancient tradition of South East Asia, in which the core of ensembles for court music is constituted of bronze percussion. Especially in Indonesia it has always been associated with power and wealth as some of the metals used in this alloy are scarce in the archipelago. These few facts have far reaching implications.

The instruments are conceived as part of an ensemble. Such ensembles exist within systems of strict hierarchy. Their use, setup and repertory have always had a formal, organized character. One could perhaps say that they operate halfway between the West African drumming groups and the Western symphonic orchestra. The main difference with these two is that traditionally the *gamelan* (often augmented with strings, winds and vocals) is not a platform supporting bouts of individual virtuosity. Most *gamelan* music is best described as classical, comparable with Western composed music and Indian raga.

Together with its beautiful metal sonorities it is the tuning systems that have grasped the attention of 20th century Western composers and musicians. Either to try and approach the timbres with conventional instruments, like Benjamin Britten and Olivier Messiaen did; or to enjoy its exhilarating sounds from within, founding *gamelan* ensembles on their own, playing in them and writing for them. I imagine that the joy of playing in one comes from being an integrated part of a larger whole, that is both organic and mechanical – with cogs of different size and pace; but also from the sensation of existing inside a metal sphere of immensely diversified resonance. There are several such ensembles in America and Europe. America even has its own Gamelan Institute, based at the same address as Frog Peak Music. Driving force behind it is Jody Diamond.

Like Frog Peak this institute has a distribution catalog from which people can order materials: monographs, recordings, video tapes and issues of its magazine, *Balungan.* Along with more traditional materials, the catalog contains works by I

Wayan Sadra, Barbara Benary (featured in *Musicworks #57),* Philip Corner, Nick Didkovsky, Daniel Goode, Lou Harrison and, of course, Diamond herself – to name a few people who may be familiar to the reader. It also shows that the institute wants to look beyond Indonesian *Gamelan* tradition to more recent forms, both in the country itself and in North America. The recordings in the catalog are even more varied in style, evidence of an open minded approach.

The cassette tape *Fantastic Gamelan* is quite what you would expect. Living up to the title it shows off various ensembles in all their splendor. The pieces are well played and reasonably well recorded/transmitted to cassette. Sound quality is of some importance. My copy of *Pangkur-Pamijen* suffers from considerable distortion, sounding as if the space in which the musicians play and sing (as projected by my headphones) gets squeezed real tight during the louder passages, which makes for some unnervingly claustrophobic listening. *Slonding* makes attractive use of the combination of attack and slow decay that characterizes the ensemble: furious rhythms cloaked in luscious resonance. Cicadas present during recording provide a steady tropical backdrop. The chorus, appearing at different stages (very probably the instrumentalists themselves), gives the two pieces on this cassette a strange Partchian atmosphere. also because some of the singers sound decidedly untrained. One cannot shrug off the impression that here is some drama being staged, but there is no telling what it is all about.

The CDs *Asmnat Dream* and *Interaction* feature new Indonesian music and new music for *gamelan* (partly by Western composers, such as Barbara Benary and Lou Harrison) respectively, compiled by Diamond and her partner, Frog Peak director Larry Polansky. Concentrating more on musical invention and sonic exploration, emphasis on the ritual aspect of the music is less in evidence. Riveting pieces most of them, the timbral details have been captured in all their delicacy.

This is especially effective in *Galura* by Nano S., an exquisite piece for *kecapi* and *rincik,* two finger-plucked zithers that radiate a warm and rich tinkling. Coming in two versions (the second with a *suling* overdub) it leaves the *gamelan* behind altogether, as do most other compositions on *Asmat Dream.* Nonetheless, the music does sound Indonesian. That is partly due to the instruments used, but also to the cyclic movement that often makes itself felt and heard. Harry Roesli's contribution, which gave the CD its title, is possibly the most curious track. As a tape composition it is farthest removed from the Indonesian tradition of serious music. Using and processing sound samples that project immediate images of tropical surroundings and a ritual setting, Roesli creates an atmosphere that has at once a realistic and surreal feel to it.

Interaction combines traditional and self-built gong-chimes with instruments from other cultures: didjeridoo, snare drum, bass trombone, a digital effects processor and a retuned piano amongst them. Harrison's idea to juxtapose gong-chimes with the one-person string percussion band (the piano, that is, retuned for the occasion) works wonderfully. Having either 'ensemble' as protagonist by turns, the composition is an amazing amalgam: neither evidently Western nor Eastern, it cannot be labeled 'fusion', either, for that matter. It is an inspiring study into the similarities and differences between these flagships and backbones of two musical cultures.

However beautiful and clever this music may be, there is an abstract (academic) quality to it that you will not find on the *Music for Sale* tape and the Folkways CDs. These cover areas and styles that are relatively unknown. The tape is a collection of songs, schlagers and a trance dance. No studio recordings: most of the work was done in the streets and market places of the Javanese city Yogyakarta. Interaction between the musicians and their audience is an integral part of the events caught. You may hear a child among the bystanders repeat to herself the last notes of a melody sung by a woman. The hustle and bustle of outdoor life, always present, lends the music a delightful directness.

"Music of Indonesia" is a series in which Folkways highlights cultural aspects of the archipelago that are off the beaten track: no *gamelan* here, although there is always at least one gong within earshot. Part 1 and 4 respectively focus on a cycle of songs to entertain people at special occasions and on music from ethnic minorities – the Batak and the inhabitants of the island Nias. On the first CD the final section of a *gandrung* program (which, in total, may take from midevening until the hours before dawn) has been singled out. The party is practically over. the drunk have passed out or gone home. Time to clean up; and, in a sense, that is what is happening. The *seblang subuh,* as it is called, derives in part from an old purification ritual. With a dignified chanteuse and a male counterpart, who gently mocks and teases her, the cycle emits a delicate atmosphere, a soft pearly glow, a contemplative and melancholy mood – matching the time of day perfectly. It must capture the heart of anybody who has once partied through the night.

Percussion lies at the basis of the music of the Karo and the Toba. The Karo use small drums (17" long, greatest width 3 ½") with a light and dry timbre and a high variable pitch. The fundamental pace is set by a large and a small gong, whilst a tiny shawm blows its rather straight melodies. This in stark contrast to the frantic, sinuous playing of a similar reed with the Toba. Pitches of the shawm and the drums are markedly lower, but there is feeling of tremendous urgency in the music. Often you'll hear the reed blower gasp and snort after endless lines of circular breathing. You'll also hear how he moves his instrument from left to right to alter the tone and intensity of its sound. From time to time there are long howls of exhortation. It's jazzy and funky, in a very curly sort of way.

Together the American Gamelan Institute and Smithsonian/Foikways provide a wide and open view on rich and diversified musical styles derived from Indonesian traditions. Sometimes it takes effort and some dedication to take a dive into another culture, but with so much excellent material relatively easy to get it is worth considering to just dip in, and from there decide how far you want to swim. So stop fumbling around with your big toe and get in: the water is just terrific.

—RvP

RICHARD LERMAN: **WITHIN EARREACH: SONIC JOURNEYS**

On CD from Artifact Recordings, 1374 Francisco Street, Berkeley, CA 94702

RICHARD LERMAN: **PERFORMANCES & INSTALLATIONS**

On cassette from Frog Peak Music, Box A36, Hanover. NH 03755

In developing technology for amplifying or recording sound the main aim has always been to make the medium transparent, No obtrusive filter should stand between producer and consumer. "Not so," sound-artist Richard Lerman from Boston must have thought. Attaching piezo-discs to materials and objects he turns these into microphones that add their resonance, their character to sounds rippling through them.

This is most straightforward in the pieces on the *Sonic Journeys* CD, recorded all around the globe with an emphasis on remote places (from a "western" perspective that is, I haste to say). There's rain on windharps on Newfoundland, sounds of the

elements in Tierra del Fuego, birds on an Argentinean cactus, grass in the Outback, Lima through glass; lots of birds, humans and, well, *sounds* – all treated as equals. Some are slightly more prosaic than this brief list suggests, others are far more suggestive and poetic. The pieces tingle with a fascinating duality of sound-sources and medium blending and yet separate.

In his performances and installations Lerman adds another dimension to the way he uses sound. Sources get manipulated, sounds as such become more tightly organized. *Changing States 2* for metal microphones and propane torches, *Travelon GameIon* for amplified bicycles and *End of the Line* for seven instruments and electronics mark various approaches towards an aesthetically conscious aggregation and integration of sonic elements. This may seem a rather ponderous phrasing of what one would normally call "composition" – and yet it most clearly maps what (in my view) is Richard Lerman's field of research: the phase of metamorphosis from sound to music, from sounding objects to instruments; and the complex shifting relationships between these. His hands and ears prove a refined set of tools for conducting such investigations.

One of the things that makes his work special is the fact that he succeeds in keeping extremes together in it: shaping intense and sophisticated pieces from basic materials, from self-built and customized implements. He has a keen ear and eye for the potential and the malleability of environments and objects he meets. An apparently inconsequential action he performs in (or on) them may invert the hierarchy of our two main senses. Shifting focus from the visual to the aural, Lerman changes one's perception of a place or an object. He transforms the world into a world of sound, and through this process makes it gain in depth considerably. The change is as radical as his touch is delicate. In more than one sense he is one of the most perceptive artists I know.

Folkways issued an album on Richard Lerman's **Travelon Gamelon** in the '80s, serial number 6241. Given their policy to keep all their issues available (either on tape or on CD) you can check it out at the following address: Smithsonian/Folkways Mail Order, 416 Hungerford Dr. Suite 320, Rockville, MD 20850; phone (301) 443-2314, fax (301) 443-1819. The CD **Echo: The Images of Sound II** (reviewed in EMI Volume VIII #2) features an excerpt from the piece as performed during the second Echo-festival in Het Apollohuis in Eindhoven, the Netherlands.

—RvP

ROD POOLE: **MESSENGER and LONELY FIRE**

On cassette from the composer at: 760 Lillian Way, #18, Hollywood, Ca, 90038

On this cassette recording, Los Angeles just intonation guitarist, improviser, and composer Rod Poole presents two extensive solo works for his guitar that has been given special fret placements to achieve a unique 19-tones-per-octave, 13-limit just intonation. The two pieces draw inspiration from a variety of Eastern musics, particularly those of India and Indonesia, as well as from contemporary American composition and improvisation via jazz, Jimi Hendrix, and well-known just intonation composer La Monte Young.

Though he is largely self-taught, two individuals with whom Rod has studied stand out as major influences in his playing and composition: Californian just intonation theorist, Erv Wilson, and English experimental improviser, Keith Rowe. It was with Erv that Rod learned the world of just intonation, incorporating within it the knowledge of scale building, tuning systems, and mathematical structures. This created the desire to realize these tunings, which led Rod to design his 19 tone guitar.

The piece "Messenger" (also titled "Darklight approaching Reason") is dedicated to the cosmic messenger, Sun Ra. It uses a 9-tone scale emphasizing the 7th and 11th harmonics and a broken tetrachord that occurs between the open strings. Though largely improvised, recurring themes abound as well as unifying/contrasting textures and rhythms. This is all made especially effective by Rod's marvelous hand technique, as when he seems to hold two or three parts moving together in rapid, rhythmic articulation.

The septimal piece (using intervals based on the prime number 7), "Lonely Fire," is much like "Messenger" in composition and improvisation, but stresses to a greater extent the Eastern quality. In the introductory sections, with their extensive use of pitchbend/gliss, Rod's guitar sounds like some bizarre cross between a Chinese ch'in (7-stringed zither) and a North Indian rudra veena (stick zither).

Though he sometimes sacrifices melody in favor of his compositional interest in harmonic tone clusters, Rod's pieces cover a lot of territory. From the valleys of gentle, subtle, intricate, classical-influenced playing, to the hills of fast, ferocious dances of bliss and rage, this troubadour of just intonation seems to tell stories of a world that has forgotten the essential, meaningful things. In Rod's words, just intonation "both connects us with the ancient past and projects into infinity."

So if you enjoy vital, energized non-equal temperament guitar music, and don't mind the rustic quality of the cassette recording (it's live, complete with cars, bugs and people), then definitely have a listen to Rod Poole's music.

—SB

GRANT STROMBECK: **SOUND WEB**

2237 Grove Berwyn, IL 60402; (708) 788-1152

In the tradition of New Music – pointillistic textures, succinct phrasing, angular lines and lots of timbre – Sound Web delightfully establishes and explores its own sound world. It is a world made up of "sample sound, multi-track tape, electroacoustic experimental instruments, alternative midi controllers and acoustic instrumentation." The angular, disjunct and generally short phrasing is reminiscent of Stefan Wolpe, Arthur Berger, Bulent Arel, Isaac Nemiroff, Vladimir Usachevsky and other East Coast luminaries of the 60s and 70s.

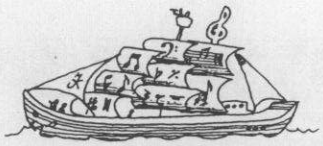
The piece "Hyperlinks" on the second side adds a further dimension to this recording in its longer, more majestic phrasing and extended virtuosic lines, while retaining the highly interactive feeling among "voices" that compliment with staccato commentary. Short silences are used effectively. Little is heard in this piece, however, of experimental instruments. It is predominantly synthesized orchestral/electronic sound.

There is a definite craft here in maintaining both a clear, almost transparent texture and rapid but sensuous phrasing with the complexity of the sound material. Strombeck meets the challenge without falling into a mass of sound or generalized texture – a temptation to most.

One rarely encounters this kind of music utilizing experimental instruments. But despite its "classical" character, a free-flowing sense of improvisation is evident in the natural continuity of the music. And it takes a good ear to mix traditional and experimental instruments with such balance on a recording.

The experimental instruments used on this tape were designed and built by Strombeck, who describes them as follows:

One of the instruments is made of nylon strings and springs stretched on a circular frame. The thing resembles a web, thus, the



sound web is the instrument's name. Another instrument is a set of beryllium copper strips mounted on a rectangular frame with springs woven into the tines of the strips. This instrument sounds like a ratchet or a motor when hooked up to a flange effect.

It's called the Flexy-protuberance. The Orb is a gong/bell made of rods welded to a stainless steel float. The Orb produces long sustaining gong/bell sounds and looks like sputnik.

I should note that the tape I heard was a "sampler" – a shorter version of the one for distribution; therefore, I cannot comment on the full version. Frankly, I have doubts about the efficacy of sending a "sampler" for review. An album, whether tape, CD or vinyl, is always a thing in itself, a larger piece, with its own form and character. (Everyone who has produced a tape or CD knows the agony involved in determining the order of the pieces!) A review of a "sample" cannot address this issue. But what I heard I liked.

—TN

A COLLECTION OF UNIQUE MUSICAL INSTRUMENTS

On CD from King Record Company (Japan), KICH 2030

Molluscan musical instrument makers, those creators of natural stone flutes in the form of pitted rocks which from time to time wash up on Pacific beaches, may have been practicing their craft for thousands and thousands of years – see Robin Goodfellow's article "Rocks in Rut" in *EMI* VII/6 – but many of us have just recently become aware of the musical possibilities of their output. This is not the case in Japan, however, where the use of stone flutes, with blow-holes naturally carved out by molluscs, or by wind or tidal currents which erode the soft parts of the stone, is many centuries old. The tradition of playing these flutes, called *iwabue* (literally meaning "stone flute"), has been passed down through the Shinto religion, where the playing of the instrument is used for spiritual cleansing and the exorcism of demons. *Iwabue* are often included in collections in Shinto shrines in Japan.

Iwabue are among the many rarely heard instruments featured on this CD collection, the Japanese title of which literally translates as "Musical Instruments, a Precious Box." *Rites for Ancient Flutes,* composed and performed by Uesugi Kodo, is a three-movement piece which features *iwabue* in its outer movements, with a central movement for ceramic flute *(tsuchibue)* accompanied by a ceramic bell *(dorei)*. The liner notes speak of the attempt in this piece to recreate music from the Jomon and Yayoi periods of ancient Japan (ca. 8000 BC-third century AD), and the music is very effective – one of the more convincing attempts at creative recreation of music of prehistoric times and antiquity.

A number of uncommon instruments of Japan's classical tradition are also included here, such as the *ichigenkin* and *kokyu*. The single-string zither *ichigenkin* saw its greatest popularity during the later Edo period (1615-1868) when it was played by scholar-artists who emulated things Chinese – although while the origins of the *ichigenkin* may be Chinese, its history is actually quite obscure. The piece included in this collection, *Fuyu no Miyabi* ("Winter Elegance") is a newly composed piece in traditional style using a text from the repertoire of the *koto* zither, performed by its composer, Yokota Chiseko. It is a virtuosic piece and shows how complex music for a single string can be. The *kokyu* is a three-string fiddle, looking very much like a small version of the *shamisen* lute. Bowed-string instruments may not seem unusual to us, but they never were very popular in Japan; as elsewhere in East Asia, plucked-string instruments have always held precedence. The piece, *Tsuru no Sugomori* ("Cranes Nesting"), is the second part of a traditional *kokyu* piece played in duet with a *shamisen*.

This collection also includes two instruments of the Ainu people of Hokkaido in northern Japan and the nearby Sakhalin Island. There is an excerpted solo for *mukkuri*, a bamboo jew's harp, as well as two pieces for the *tonkori* zither. The *tonkori*'s five strings are commonly tuned to a non-consecutive pentatonic scale (the pitches falling and rising by fifths and fourths from one string to the next) and are plucked with both hands. The two pieces for this rare instrument – *To Kito Ranran* (translated as "Cranes Have Come Again This Spring," although the Ainu title would seem to be onomatopoeic of the sound of the piece's basic repeated two-beat phrase) and *Ponsumari Hechire* ("A Dance of a Little Fox") – are among the highlights of this collection, and are performed by Kanaya Eijiro.

The collection also includes the percussion instruments used in the rituals of the Soto sect of Zen Buddhism, as well as songs of Kagoshima, Kyushu, accompanied by the *gottan* (a *shamisen* with a body made entirely of Japanese cedar), and solos for the bamboo *tempuku* flute, also of Kagoshima. The accompanying booklet, in Japanese and English, includes photographs of all the instruments, some shown being played.

It is unfortunate that some of the selections on this album are excerpts of longer pieces: the *kokyu* piece mentioned above omits its opening section, and only the first three movements are included of the seven movements of *Sugagaki,* for Okinawan *koto.* Still, this is a wonderful glimpse of some of the rarer musical traditions of Japan. The selection that does seem out of place here is the last one (the longest on the album), a contemporary five-movement piece for *sanjugen*, a modern thirty-string *koto.* Although other selections, such as those for *iwabue* and *ichigenkin,* are also contemporary compositions, they explore traditional instruments largely in a traditional style. As interesting as this last piece is, it would seem to belong to another possible series for King Records, one of Japan's incredibly active contemporary music scene, especially the new music for traditional and adapted traditional instruments.

A *FURTHER READING* Bit: A number of the instruments included on this collection are described in Koizumi Fumio, et al, *Asian Musics in an Asian Perspective* (Tokyo, 1977). This compendium on traditional Asian musics features detailed photographs and measured drawings for the instruments it describes. Information in English on the *ichigenkin* is sparse, but Robert Hans van Gulik in his *Hsi K'ang and his Poetical Essay on the Lute* (2nd edition, Tokyo & Rutland Vermont, 1969) manages to fit a good bit of information on the *ichigenkin* (and the Chinese instrument which may be its progenitor) into a footnote – number 247, on page 48. Some information, in Japanese, on the *iwabue* may be found in the book *Nihon no Gakki* ("Musical Instruments of Japan") by Motegi Sayoko (Tokyo, 1988), which includes a number of photographs of *iwabue* from various locales in Japan, on pages 26, 68 & 69. And of course there's *The New Grove Dictionary of Musical Instruments.*

—MC

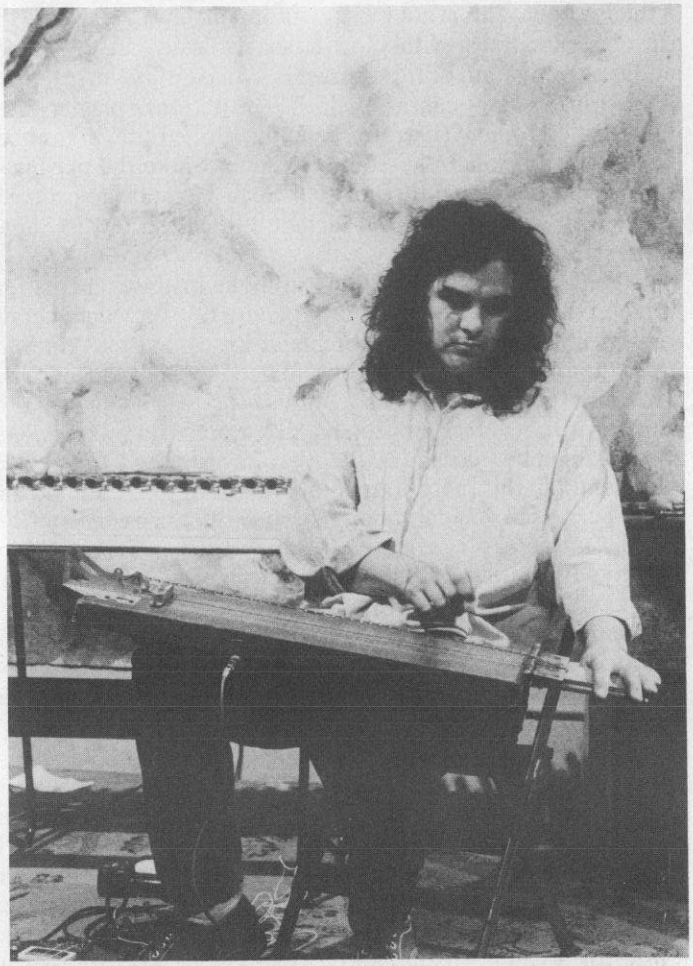
THE EXPERIMENTAL SOUND STUDIO INVENTED INSTRUMENTS ENSEMBLE

Article by Hal Rammel

Photographs by Debra E. Levie

Chicago's **Experimental Sound Studio** began workshops on musical instrument design and construction in 1990. These sessions have been titled "Instrument Invention & Sound Exploration" and have been conducted by myself with the assistance of visiting artist Douglas Ewart. The emphasis is on designing, building, and playing unique acoustic sound sources using recycled and found materials and simple building techniques. Multicultural historical and contemporary vernacular traditions of home-made instrument building consistently offer points of entry into new acoustic worlds. As the interests of beginning instrument builders often turn toward strings and percussion, Douglas Ewart's lifetime of experience working with bamboo in the construction of wind and percussion instruments has been invaluable in expanding the range of our mutual instrument exploration.

From the beginning these workshops have emphasized musical performance as an integral part of sound exploration, structuring the sessions to culminate in a concert performance by the newly invented and built ensemble. In 1990, 1991, and 1992 this performance was featured in the *Chicago Invented Instruments Festival*. In 1993 the program expanded to include a second series of workshops expressly designed to explore these unique instruments in a variety of improvisational and compositional situations. "Performance and Composition for Invented Instruments" was co-led by composer Gene Coleman and myself to develop approaches to ensemble performance with unusual sound sources. For example, an improvisation might be conducted with various hand signals indicating shifts to duo or trio passages, changes in tempo or dynamics gradually or abruptly on cue, transitions to arco or percussive sounds, and so on. Gene introduced ideas of graphic notation and scoring systems. The design and modification of instruments was ongoing throughout the sessions. Many of the participants in the Fall 1993 workshop have taken



PHOTOS ON THESE PAGES

Facing page, left:
Greg O'Drobinak

Facing page, right:
Steve Rom

This page, right:
Karen Westling

This page, below:
Steve Barsotti

previous instrument building workshops at ESS and performed in the ensemble. The instruments they play have been developed over the course of several years. Our performance in 1993 took place at the HotHouse in Chicago as part of its monthly new music series "Face the Music." For further information about workshops and other events at the Experimental Sound Studio, contact 312/784-0449.

In the facing page photo far left, Greg O'Drobinak performs with two instruments developed over the course of several years in the Experimental Sound Studio workshops. To his left stands the Toaster Tower built around a discarded wire record rack. Various cymbal and gong sounds are produced by the toaster "shell," metal industrial lamp shades, and brass bowls fixed to or suspended from this frame. Additionally, six vertical rods clamped to the structure produce string bass sounds when bowed. Standing in the foreground is Greg's Ark of the Oven; its wooden frame sits on top of a battery of various digital signal processing units. The primary sound component is an oven grate fastened to the pine base of the structure. An oven pan is suspended by springs and wires above it. Five telephone bells are mounted across the top and a set of brass cups are fixed to the sides, all of which may be bowed or struck. Both the Toaster Tower and the Ark of the Oven are amplified with multiple piezo microphones and their signals modified by an extensive array of digital processing combining reverb, delay, and pitch shifting. Thus, for example, ring modulation with reverb used on the Toaster Tower produces tones ranging from thick low-pitched bass to whale-like screeches. In the photo Greg is shown bowing the oven grate at a point where the tines have been cut on a diagonal to produce distinct pitches. Greg's instrument experimentation concentrates on bell and gong sounds in his work with tuned and untuned metal, very much in keeping with his interest in gamelan music. He has been active in Chicago's gamelan ensemble Friends of the Gamelan since 1987.

Karen Westling, shown above, applied her skill and experience as a professional piano-tuner in building this two-octave copper-tubing metallophone (extending from B flat below middle C to two octaves above). Each piece of tubing was tuned by ear with the aid of a well-tuned piano and tuning forks. The copper tubes rest on elastic bands running the length of the wooden frame. Push pins between each copper

tube support the lower elastic band above the surface of the frame and a second band, wrapped once around each tube, fixes the tubes in position. Karen plays the metallophone with a violin bow or with various mallets of her own design using superballs and wooden dresser knobs wrapped with layers of balloon, cotton cloth, and tire rubber. Karen also constructed a copper tubing slide whistle for the ensemble, combining a length of discarded copper tubing with pieces from a commercial plastic slide whistle. Fingerholes were drilled out randomly in the copper tubing inserted between mouthpiece and slide. Instead of evenly ascending or descending tones the whistle makes sudden unexpected leaps in pitch due to the combination of fingerholes and slide ... or can be played as a more conventionally fingered flute.

String instrument builder Steve Rom is seen here (page 36, right) playing amplified window chain, constructed in the fashion of a lap steel guitar. Built from a piece of wooden ceiling rafter with a joist hanger as the bridge, a piece of copper-coated steel window chain is amplified with a Hot Strat pickup. The chain is attached to a hinge at Steve's left and a piece of oak flooring is fastened to the hinge adding leverage for minute variations of the chain's tension. Striking the chain with a wooden bar produces a wide variety of pitches and overtones. At high volumes sustained feedback can be produced and controlled. Older chains offer greater possibilities for. manipulating this feedback while newer chains create subtle clinking sounds with slight changes in tension. Steve also plays the pickup itself with various cordless drills, motorized screwdrivers, hand mixers, and eggbeaters whose differing RPMs produce a dramatic variety of roars and mutterings. Steve has been a guitar builder for 20 years, specializing in customized guitars for collectors and in fine tuning guitar design for versatility and accessibility to a wide variety of stylistic approaches. Steve's other contribution to the workshop ensemble included his "built-from-scratch user-friendly cookie can banjos" and a thunderous five-gallon variable-tension one-string bucket.

Steve Barsotti, in the lower photo on page 37, prepares to strike two instruments he explored during the workshop. Uppermost sits the square steel structure of the Grill Harp in which a circular cooking grill is held in place by springs. Almost constructivist in appearance, Steve relates that "its interesting quality as a visual piece came as something of an afterthought." Striking and scraping sounds on the Grill Harp are relatively soft acoustically so it was frequently amplified with a contact microphone placed at different points on its surface. In this photo and for the performance Steve set the Grill on top of a milk canister that had a contact mic placed on it. The milk can is intended as the foundation of a future string instrument but in itself displays a remarkable array of resonant singing tones all over its form (the rim, handles, bottom, the various contours of its sides). The contact microphone amplifies both objects (though the milk canister is acoustically quite resonant) and allows Steve to manipulate the signal with analog delay and parametric EQ in real time as part of his improvisation. Steve is active as a sonic artist in the Chicago area focusing on studio-based works in addition to building and recording electro-acoustic instruments. The Grill Harp and milk canister pictured here reflect his fascination with sounds and objects whose simple raw forms belie a wealth of mystery and sonic intrigue.

In the photo below, the Experimental Sound Studio Invented Instruments Ensemble performs at the HotHouse in Chicago on November 14, 1993. For a final improvisation the ensemble expanded to sextet format with the addition of co-directors Hal Rammel and Gene Coleman. Hal Rammel plays his own acoustic 36-string bowed aerolin (made from a table leg supporting a circular arrangement of violin strings around the rim of a steel pan). In this photo Gene is playing the *gar klein* recorder (a recorder with its lowest note C_6 two lines above the treble cleff ranging upwards not quite two octaves), although he also played shortwave radio in a number of ensemble improvisations.

Photo below: The ESS Invented Instruments Ensemble in performance

instrument for one-handed playing, and, to place this in context, provides some history of one-man band entertainments in the instrument's time and place of origin.

"Making a Bowed Keyboard Instrument" by Akio Obuchi: a report on a modern Geigenwerk (piano with strings sounded by rotating friction disks) made by the author.

Among the articles in **American Lutherie** #36, Winter 1993 (8222 South Park Ave, Tacoma WA 98408):

"Historical Lute Construction: The Erlangen Lectures, Practicum, Part 14," by Robert Lundberg: This is the final installment in what has been a monumental series appearing over the last seven years. The topics this time are fretting (including both tied-on gut-string frets and the glued-on wooden body frets) and stringing.

"The Ukranian Bandura: A Distant Relative of the Harp Guitar," by Francis Kosheleff: In response to earlier articles by Jonathon Peterson on harp guitars, Francis Kosheleff provides this report on the Ukranian instrument with its 400-year history.

"Heed Herr Helmholtz, or How I Built My First Guitar Twice," by Mike Doolin: An instructive, if unassuming, account of one builder's experience with the importance of properly tuned air resonance in a string instrument body.

"Making Flat Cases," by John Calkin: practical instructions for making instrument cases for guitar-like instruments.

Among the articles in **Musicworks** 59 (179 Richmond St. West. Toronto, Ontario, Canada M5V 1V3):

"The Art of Coexistence," by René van Peer: A look at the work of several composers who work with live or recorded bird sounds, mingled with the author's thoughtful observations about the place of the human listener in nature.

"John Cage Poses a Few Last Questions," by Margaret Leng Tan (originally published in the New York Times): This is one of a set of reminiscences of John Cage from several authors in this issue of Musicworks. Margaret Leng Tan discusses (in a philosophical and elegiac sort of way) compositions for toy piano, bowed piano and prepared piano.

Also recently available from *Musicworks* at the address given above: a fully indexed back issue catalog, with subject matter headings including installation and sound art, instrument design and construction, microtonal music, and sound sculpture, among the many other topics this journal has touched upon in its sixteen years.

Among the articles in **FoMRHI Quarterly** #76, July 1994 (c/o Faculty of Music, St. Aldate's, Oxford OX1 1DB, U.K.):

"Plans of Instruments," A listing of plans for historical instruments available from the Museum of Instruments at the Royal College of Music in London.

"On Writing a History of the Oboe in the Nineteenth Century," by Geoffrey Burgess: A fairly detailed account of the development of the oboe during the time period described.

"Early Sound Generation: Bassoon Reeds," by Paul White: notes on and illustrations of early double reeds, coupled with thoughts on authenticity and lack thereof in modern reproductions and performance.

"Making one's Mark," by Graham Lyndon-Jones: further notes on marking musical instruments (adding the maker's name or logo by stamping and other processes), following earlier remarks on the subject from another author in the preceding issue of this journal.

Recent Articles in Other Periodicals

The following is a listing of selected articles relating to musical instruments which have appeared recently in other publications.

"Un Xylophone Madinda" by Michel Faligand, in **Percussions** No. 35, July-Aug 1994 (18, rue Theodore-Rousseau, F77930, Chailly-en-Bierre, France).

Notes on the construction of a Madinda xylophone, generously illustrated with line drawings. In French.

"Musical Car Parts", in the *What's New* column of **Popular Science**, October 1994.

A blurb on the creation of a set of musical instruments made from the remains of a beloved old car, with a photo of the string bass that the gas tank became.

"Vanguard Composers in San Francisco" in **P-Form** no.33, Fall 1994 (756 N. Milwaukee Ave., Chicago, IL 60622).

One of three composers discussed in this article is Brenda Hutchinson, one of whose instruments is a musicbox-like rotating drum, which she programs during performance by inserting pushpins which trigger glockenspiel-like bars.

"Amazing New Fibracell Synthetic Reeds are Now Proudly Offered by Leblanc" in **TechniCom** Vol 19 #3, May-June 1994 (PO Box 51, Normal, IL 61761).

The latest in the quest to create synthetic clarinet and sax reeds instruments that play like natural cane.

"Intonation and Temperament" by Ted Rust, in **Music For the Love of It** Vol. 7 No. 4, August 1994 (67 Parkside Dr., Berkeley CA 94705).

A very readable brief introduction to the idea that the standard 12-tone equal temperament tuning need not be the final word.

Also in this issue of **Music for the Love of It**: "Returning to Music: The Bell Choir" by Jean Nix – a discussion of what a pleasure it is to join a bell choir.

"The twilight zone: ai confini della realtà" by Gianluigi Gasparetti, in **Deep Listenings** #4, Spring 1994 (Viale Alessandro Magno 264 - 00124, Rome, Italy).

A report on music and instruments by Q.R. Ghazala. In Italian.

"Acoustics of the glass harmonica" by Thomas D. Rossing, in **Glass Music World** Summer/Fall 1994 (2503 Logan Dr., Loveland CO 80538).

The first part of an article originally published in the **Journal of the Acoustical Society of America**, opening with a brief history and continuing with a discussion of vibrational modes.

"The Czech Music Industry" (no author credited), in **Music Trades** August 1994 (PO Box 432, Englewood NJ 07631).

A look at commercial musical instrument manufacturing in Czechoslovakia, with background information on recent political history, global market commercial considerations, and lots of the hands-on factory-floor photographs that *Music Trades* specializes in.

"Gibson Turns 100", also in the August issue of **Music Trades** (address above).

A 16-page history of the venerable guitar manufacturing company, with some historic photographs plus lots more of modern manufacturing processes.

"Why Bach Brass Dominates", in **Music Trades**, September 1994 (address above).

More photographs of commercial instrument manufacturing processes from *Music Trades*, this time devoted to production facilities at the Bach brasswinds company.

"The Japanese Sound Culture" by Tadahiko Imada, in **The Soundscape Newsletter** No. 9, September 1994 (Simon Fraser University, School of Communication, Burnaby, BC, V5A 1S6, Canada).

A one-page article discussing some traditional Japanese environmental sound aesthetics – sounds, sound-making devices, and people's responses to them.

– And in the previous issue of **Soundscape Newsletter** (Number 8; address above), a lovely essay on listening by Steven Feld entitled "From Ethnomusicology to Echo-muse-ecology: Reading R. Murray Schafer in the Papua New Guinea Rainforest."

Woodwind Quarterly #6, Feb 1994 (1513 Old CC Rd., Colville WA 99114) includes a range of articles on woodwind making, with this issue being particularly rich in both historical and practical technical information.

"Stringband Evaluation, Part 1" by Joseph Jourdain, in **Folk Harp Journal** #84, Summer 1994 (4718 Maychelle Dr., Anaheim, CA 92807-3040).

The author has created software for string scaling (determining optimal string types, lengths and diameters) in harps. He writes this article in response to previous articles by another producer of string-scaling software, Mark Bolles. Jourdain outlines differences between their two approaches, giving his reasons for preferring his own approach.

"Another Pneumatic Harp!", by Dick Hoar, also in **Folk Harp Journal** #84 (address above).

Notes and photographs on the making of a pneumatic pedal action, used in harps with seven strings to the octave to introduce sharps by means of a string-stopping action that raises string pitch a semitone.

Among the articles in the 1994 issue of the **Journal of the American Musical Instrument Society** (RR#3, Box 466, Lyme NH 03768):

"West African Harps", by Eric Charry: A fifty-page study of instruments of the sort sometimes called "harp-lutes", including *kora*, *simbi* and others.

"The One-Man Band in Eighteenth-Century Spain and Instrument Number 89.4.1039 in the Metropolitan Museum of Art, New York," by Beryl Kenyon de Pasqual: The guitar-like museum instrument described here has been a mystery instrument, with several peculiar and unexplained features including a long arm of iron extending down over the nut. The author offers the explanation that it was designed as a semi-automated

(Continued on page 39)